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Technological developments, which have improved and increased the audiovisual materials and mechanical aids available, can be especially useful to teachers of science, math, and foreign languages. This technology revolution is not a threat to teachers, but a source of educational tools to be used as a part of an overall teaching design. Most important to this design is an awareness of the right audiovisual aid for the right task. It is the teacher who must be able to combine conventional instructional methods with the new techniques of individual instruction and the new techniques of mass instruction. Instructional tools which have become more versatile as new uses for them have been suggested are the overhead projector and the opaque projector, as well as the non-projected resources of the classroom environment. Language laboratories have proved their effectiveness, and some can be installed simply and inexpensively. As with other instructional tools, the key value of television is its effective use in conjunction with classroom instruction. Teaching machines and programed texts, aimed at the individual's learning rate, can be used in multiple ways. Analysis of school activities suggests many opportunities for improving instructional methods which cannot themselves be separated from subject content. (SE/MT)

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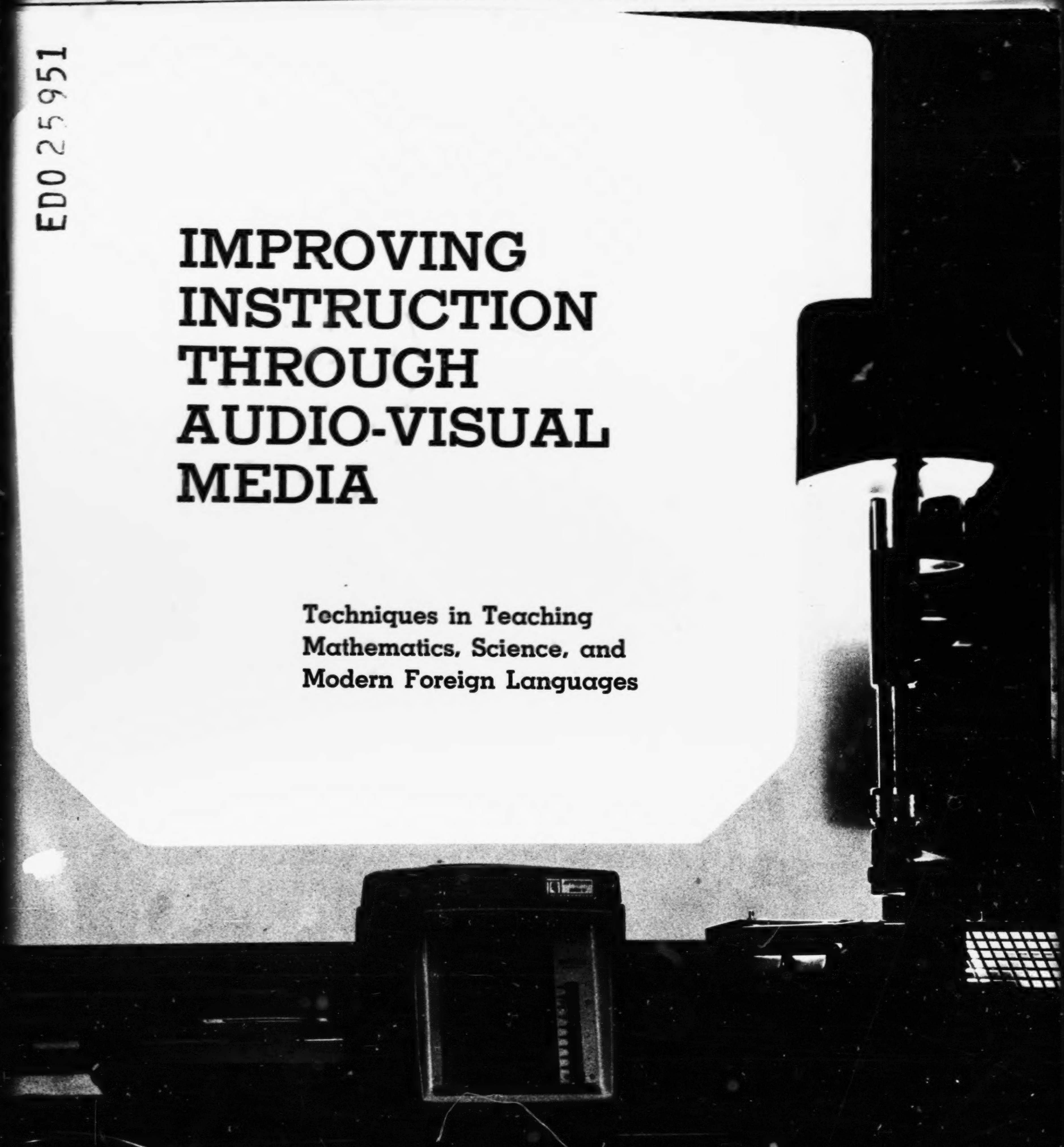
IMPROVING INSTRUCTION THROUGH AUDIO-VISUAL MEDIA

Techniques in Teaching Mathematics, Science, and Modern Foreign Languages



CALIFORNIA STATE DEPARTMENT OF EDUCATION
MAX RAFFERTY, Superintendent
of Public Instruction
SACRAMENTO, 1963

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IMPROVING INSTRUCTION THROUGH AUDIO-VISUAL MEDIA

Techniques in Teaching Science, Mathematics, and Modern Foreign Languages

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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TRIGONOMETRY

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EM007060

Foreword

The National Defense Education Act, passed in 1958, made funds available for the utilization of new media of communication in the educational program offered by the public schools. The purpose of this provision was to bring about improved educational opportunities for youth and thus strengthen the security of the nation.

"New media in education" is a broad term that includes commonly accepted audio-visual education equipment and materials and recent developments in language laboratories, educational television, teaching machines, and other technological aids.

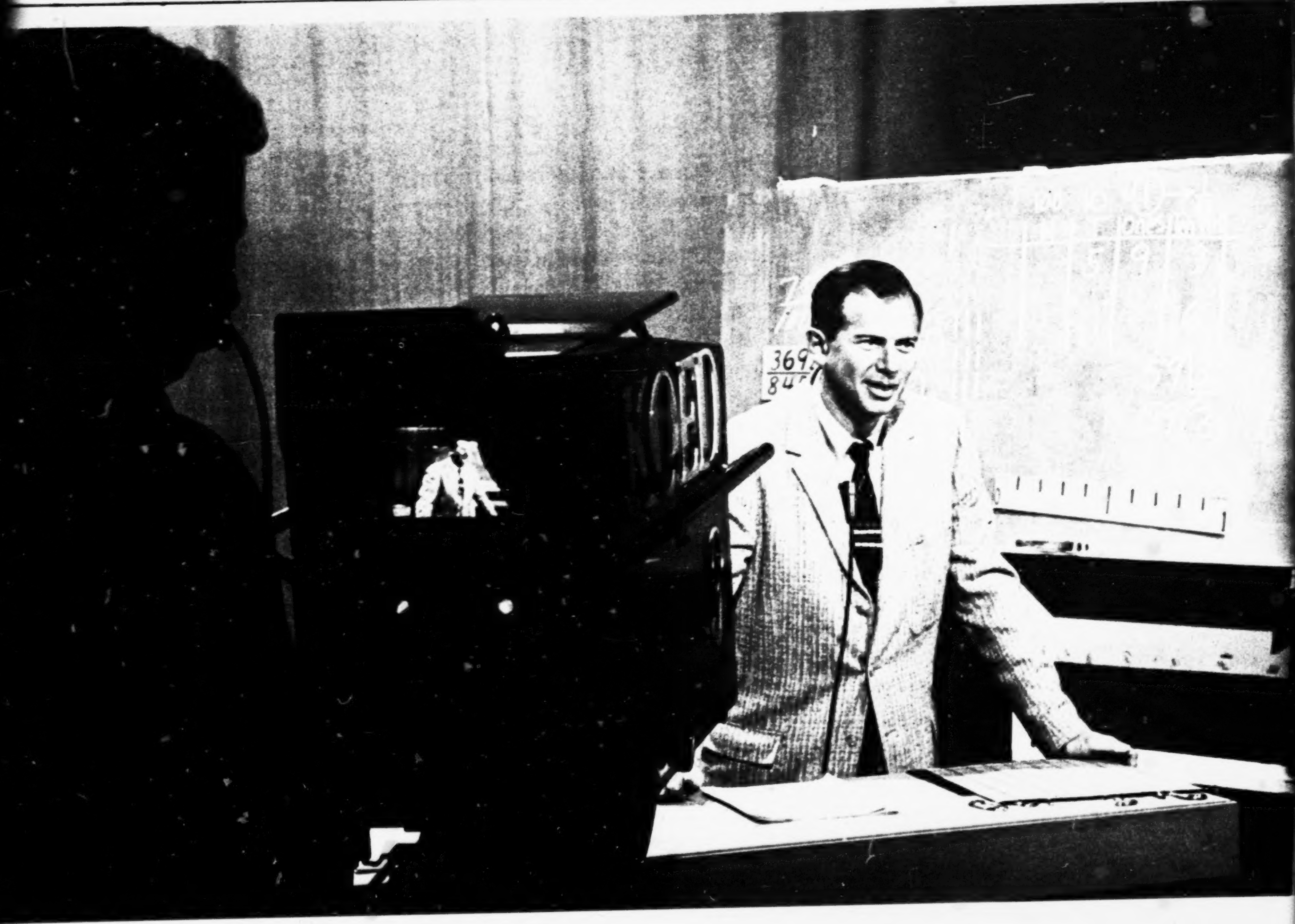
Although California schools, because of their generally well-established audio-visual education programs, were in a favorable position to move ahead rapidly with the implementation of the Act, the impetus given to the roles and functions of these new media made it necessary for the State Department of Education to provide additional leadership in their use. Many NDEA projects approved in California involve the purchase and use of recently developed audio-visual media of instruction as integral parts of carefully prepared plans to improve instruction in the curriculum areas covered by the federal legislation.

The provision of the Act that makes it possible to obtain the services of experts in the proper use of communication media, particularly the newer ones, has proved most helpful to many American schools. In California a group of special consultants, selected on the basis of specific abilities, was recently made available for in-service education purposes. These men worked throughout the state to supplement the resources of the Bureau of Audio-Visual and School Library Education.

It is anticipated that the printed reports of these specialists contained in this bulletin should prove of value to California's educational program and should affect sound utilization of new educational media within the classroom.

Max Rafferty

Superintendent of Public Instruction



Preface

The passage of the National Defense Education Act has focused attention on the use of commonly accepted audio-visual materials and on the importance of experimenting with the use of newer media, such as language laboratories, educational television, and teaching machines, in the improvement of instruction. The legislation has resulted in greatly increased demands for professional services from audio-visual personnel. An indication of such increase may be illustrated by the fact that during the first few years of operation of the Act the total expenditure for audio-visual education in California has increased by approximately $2,400,000 per annum as a result of approved projects conducted by school districts under NDEA provisions. Much of this expenditure has been made for materials and equipment involving recent innovations, such as language laboratories and educational television, thereby creating additional needs for in-service education specifically in their use.

In order to help meet these newer and additional demands on the staff of the Bureau of Audio-Visual and School Library Education and on audio-visual directors at the city, county, and district levels throughout California, a special panel of experts was selected to provide specific help in certain areas of need. The services of this panel were made possible through provisions of Title III-B of the National Defense Education Act, which provides for in-service education assistance from the state level. The panel consisted of leaders chosen because of their state and national reputations in their special areas of interest and training. Among the fields in which it was believed necessary to employ these advisers were automation in education, educational television, language laboratories, the use of projected and nonprojected materials in teaching mathematics and science, teaching machines and programming, and cross-media utilization of audio-visual techniques. The members of the panel of special consultants who were selected to assist were the following:

William H. Allen, *Director of Research, Department of Cinema, University of Southern California*

Sidney C. Eboch, *Director of Audio-Visual Services, Alameda County State College*

James D. Finn, *Professor of Education and Head, Audio-Visual Department, University of Southern California*

Frank M. Gulick, *Assistant Superintendent in Charge of Instruction, Ventura Union High School District*

Leslie Janke, *Head, Department of Librarianship, San Jose State College*

Jerrold E. Kemp, *Associate Professor of Education, San Jose State College*

Richard B. Lewis, *Professor of Education and Head, Division of Audio-Visual Services, San Jose State College*

William B. Sanborn, *Director of Instructional Materials, San Francisco City Unified School District*

Howard A. Slatoff, *Associate Dean of Students and Associate Professor of Art, Alameda County State College*

The chapters in this publication were prepared by these special consultants in an attempt to capture in printed form the basic contributions of their presentations. The vast strides that have been accomplished in audio-visual education have made it difficult to cover adequately all phases of its progress. However, *Improving Instruction Through Audio-Visual Media* attempts in a simplified way to impart to teachers information of practical value that might be used to advantage in augmenting classroom instruction.

The work of the special consultants in making this publication possible is gratefully acknowledged. Appreciation is also expressed to John O'Lague of the office of the Alameda County Superintendent of Schools, who was responsible for its organization, layout, and design.

RICHARD M. CLOWES
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CHAPTER I

TECHNOLOGY—POTENTIAL FOR EDUCATIONAL REVOLUTION?[1]

JAMES D. FINN
Professor of Education
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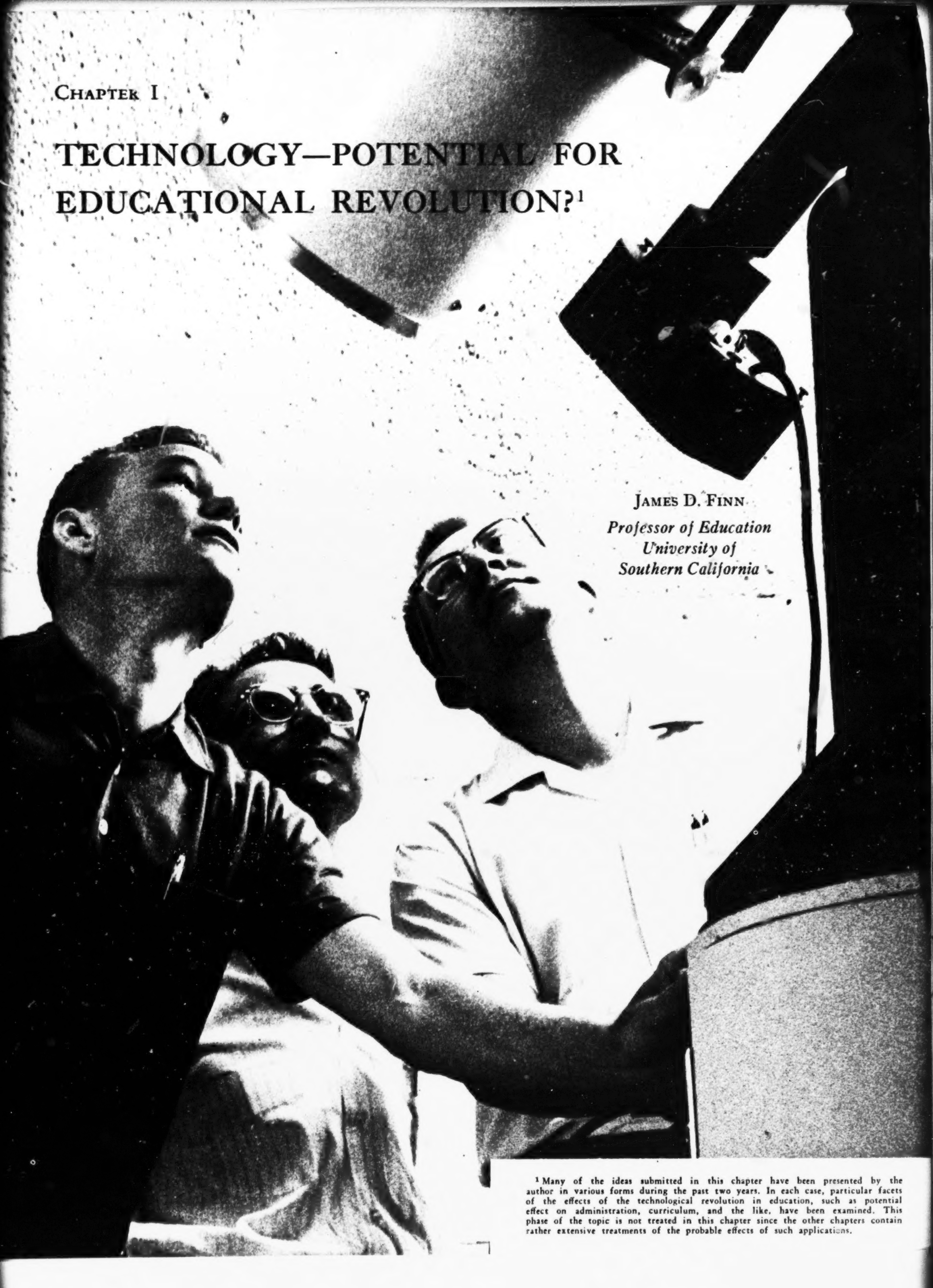
Southern California



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[1] Many of the ideas submitted in this chapter have been presented by the author in various forms during the past two years. In each case, particular facets of the effects of the technological revolution in education, such as potential effect on administration, curriculum, and the like, have been examined. This phase of the topic is not treated in this chapter since the other chapters contain rather extensive treatments of the probable effects of such applications.

American education has entered an era that historians of the future could mark as the beginning of a technological revolution; but a revolution in instructional technology exists only in potential at the present time, not in fact.

Much of the talk about teaching machines, television, and programmed learning, insofar as it is influencing practice, is still only talk. On the other hand, there is wide experimentation with the newer media, coupled with a nationwide need to improve education. There have been substantial successes with certain portions of the technology of instruction—notably with the language laboratory and with television. These developments, together with related pressures within our society stemming from industry, foundations, the international situation, and government, all add up to compelling reasons for believing that talk will soon be replaced by action.

When confronted with the proposition that a technological revolution in education is likely, a substantial segment of the profession—including all shades of educational persuasion from basic educationists to old-time progressives, and from science professors to nursery school teachers—gets pretty disturbed. This disturbance is due in part to the fact that the concept of a technology of instruction is not widely understood.

A superficial concept of technology—any technology—equates it with hardware. If educational technology is seen to consist of hardware, the ancient bugaboo of machines replacing men (in this case, teachers) instantly arises. More important, because machines are nonhuman and education has always been a humanistic enterprise, another worrisome notion is added—that education will become a completely automated, robot-directed process with all its humanity squeezed out. Still another is that an organization of machines such as a television system can move control of the educational process from local control to that of the state or the federal government, of a foundation, or a group of physics professors.

Now it may be that all of these events will come to pass. If they do, however, it will be for social reasons, not because of a technology of instruction. Technology is by no means exclusively hardware—it includes machines, but it also includes systems, organization patterns, and attitudes toward as well as methods for solving problems.

No one familiar with the general history of technology would deny that technology directly affects the social order. Technology is the tool of a society on the move and is used for whatever purposes are deemed important by that society. In this sense, technology is neutral. A technology of instruction will not make education less humane, nor will it destroy the personalities of teachers or students *unless a social decision is made to use it for that purpose.*

A highly organized technological system of instruction possibly would lead to the installation of new and different controls upon education. However, the possibility is not the requirement. The issue of control, an issue that was present before instructional technology, is one that will continue to exist even if man is reduced once again to writing on the walls of a cave.

We have to evaluate the possibility of a technological revolution in education in terms of the serious problems faced by American society in the remaining decades of this century. Since we must solve or alleviate many of these problems in the next few years, educators must think about instructional technology in the perspective of these problems; it is in this context that the crucial social decisions must be made.

Any American who has remained conscious most of the past 20 years should know about these problems by now. It seems unnecessary to list them here in detail. There are problems of the cold war, of the population explosion, of the explosion in knowledge, of the race for space, of finances and natural resources, of urbanization, and of the problems created by automation and industrial production. And there are others. But these problems all have one element in common. They cannot be solved without more and better education than we now have.

To say that we can continue to use without any changes the ways of Horace Mann or of any of his successors of whatever stamp or variety and meet these new educational demands is to say that we will use a cow as transportation to the moon. More, continuous, and better education for all of the Amer-

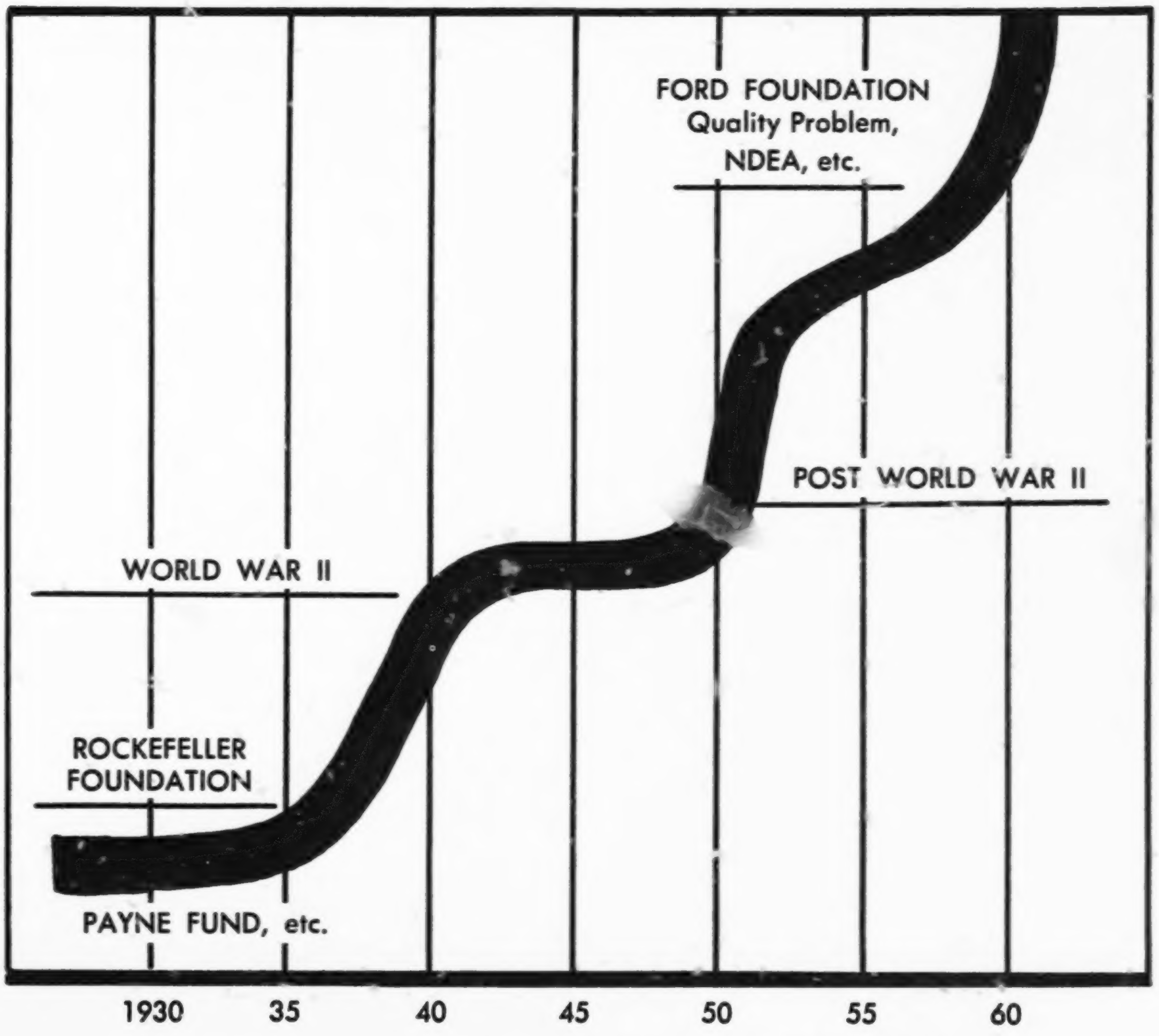


Figure 1—GROWTH OF INSTRUCTIONAL TECHNOLOGY

ican people demands new ways. The new ways that are suggesting themselves are technological ways—machine ways, if you will. Technology consists of more than machines, but machines are the best index of technology. It would help us in understanding the potential technological revolution in education if we took a closer look at hardware, keeping in mind that hardware is, at best, an indicator of the state of the art of a technology at any given time.

A graphic representation of the growth of a technology of instruction might look something like Figure 1. Whatever test might be applied—the number of projectors in schools, the number of film libraries, the extent of research, and the like—the three bumps on the curve, the significant points, can be established even if their extent cannot.

The introduction of audio-visual materials and devices for the purpose of improving instruction was a slow and painful process until the middle 30's. The infusion of money for research in this field, principally by the Rockefeller Foundation, the attention of groups of very talented men, and the availability of better materials and machines contributed to a rise in the growth of instructional technology from the middle 30's to the beginning of World War II.

As with all educational activities, a slowdown occurred during the war, and the lack of equipment and materials set back the movement somewhat. However, the technology of instruction, which moved over into areas of industrial and military training during the war, was based principally on the previous findings of the educational research and development activities of the 30's and was successfully implemented by the necessary money and talent. It was during this period that self-instructional devices also came to the forefront, although Pressey and others had been working on this problem long before.

Following World War II, great public interest in the use of audio-visual materials developed, and during the decade 1945-1955 another upsurge occurred as this technology was introduced into education with some force. Of all the levels of education, higher education was the least affected. Oriented to the printed word and the lecture system, higher education more or less successfully resisted this movement.

Since 1955, due to a variety of causes—the application of television, the influence of Ford Foundation projects, the attempts to find solutions to the problems of quality and quantity in education, the National Defense Education Act, and similar efforts—the curve of instructional technological development has again started up sharply with no leveling-off point in sight in the immediate future.

If we take the period of the last curve and project it slightly into the future, say 1955-65, the dimensions of this potential technological revolution in education become clearer. An outline of these developments follows:

INSTRUCTIONAL TECHNOLOGY DEVELOPMENTS

1. EQUIPMENT
   - a. Television
     - (1) Broadcast
     - (2) Low-power translators
     - (3) Closed-circuit
     - (4) Videotape
     - (5) Stratovision (airborne)
   - b. Electronic teaching laboratories
     - (1) Language laboratories
     - (2) Language laboratories plus visual devices
     - (3) Mobile laboratories
   - c. Self-instructional devices
     - (1) Reading pacers
     - (2) Individual listening and viewing devices
     - (3) Programmed and scrambled books
     - (4) Teaching machines

- d. Newer developments
    - (1) 8 mm sound film
    - (2) Thermoplastic recordings
    - (3) Multiple projection systems
    - (4) Telephone recorders
    - (5) Telecast systems

2. INSTRUCTIONAL SYSTEMS
    - a. Massed film systems
        - (1) Encyclopaedia Britannica Films series in physics
        - (2) American Institute of Biological Sciences series in biology
        - (3) Other
    - b. Instructional packages
    - c. Instructional system prototypes
        - (1) Physical Science Study Committee system—physics

3. ORGANIZATIONAL CONCEPTS
    - a. Stoddard
    - b. Trump
    - c. Team teaching

4. OPERATING ORGANIZATIONS
    - a. Ford Foundation
    - b. National Science Foundation
    - c. Learning Resources Institute
    - d. Educational Media Council
    - e. Educational Facilities Laboratories
    - f. Department of Audio-Visual Instruction, NEA

5. NATIONAL DEFENSE EDUCATION ACT

6. INDUSTRIAL DEVELOPMENT
    - a. Publishing
    - b. Electronics
    - c. Noneducational industries such as the Aero-Space industry

The list of developments is interesting enough. However, a list is not a statement of trends. Figure 2 illustrates one trend that is becoming apparent. Due to the more rapid development of audio-visual devices such as the film, the first technological developments apparent to educators were those associated with mass instructional techniques such as the motion picture and radio in the 30's, and later with television. By 1960 we had the possibility of a fairly sophisticated technology for mass instruction.

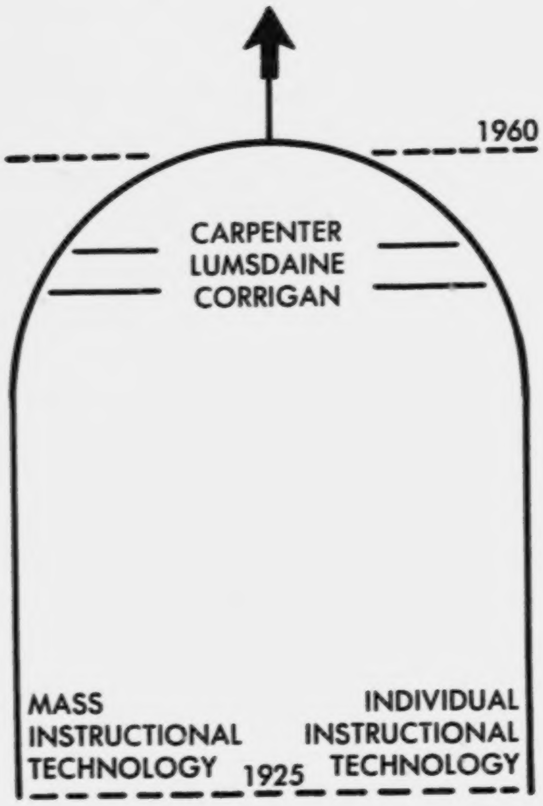
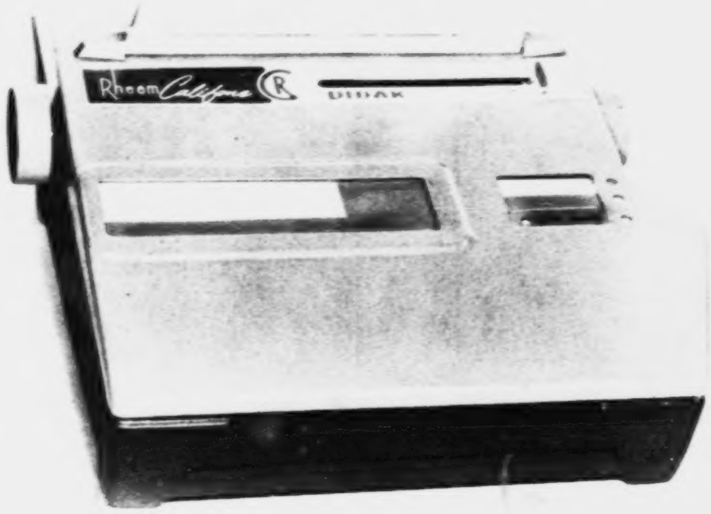

1960
CARPENTER
LUMSDAINE
CORRIGAN
MASS INSTRUCTIONAL TECHNOLOGY
INDIVIDUAL INSTRUCTIONAL TECHNOLOGY
1925

Figure 2—DOUBLE PRONGED TECHNOLOGICAL GROWTH

In the meantime, a technology of individual instruction was also being developed, although much more slowly. As mentioned before, Pressey had been working on what turned out to be a teaching machine at Ohio State University before 1920. However, it wasn't until the early 50's, with the work of Skinner at Harvard and related but independent work of military psychologists like Crowder and Chapman, that teaching machines and programmed learning came to the forefront. The work of Pressey was also revived. Suddenly, it seemed, American education was presented with a technology of individual instruction.

Actually there were other elements in the developing technology of individual instruction that are now



being fitted into the picture involving teaching machines and programmed learning. These other elements, whose ancestor was probably the old Keystone stereograph, included listening units for individual or small groups of students, individual filmstrip equipment, and slide-viewing devices. Teachers in the western part of the United States have been successfully using such devices since immediately after World War II.

Teaching machines, programmed books, listening and viewing devices, reading pacers, and the like are the basis for a technology of individual instruction. It was inevitable that research workers would start inquiring into the possibility of combining the two technologies—individual and mass. About ten years ago, Carpenter at Pennsylvania State University experimented with a program analyzer device in a classroom that combined film use with individual response, including knowledge of results. More recently, Lumsdaine and Klaus at the American Institute for Research studied the Harvey White physics films as used on television in combination with a programmed book. Corrigan and Luxton have developed a response device designed to apply teaching-machine principles to television viewing. This device is being initially tested in California by the State Department of Education.

The trend suggested in Figure 2, the possibility of combining the technology of individual instruction with the technology of mass instruction, suggests another trend shown in Figure 3: the possibility of developing an instructional system from a combination of the two technologists with "conventional instruction" (all other instructional techniques).

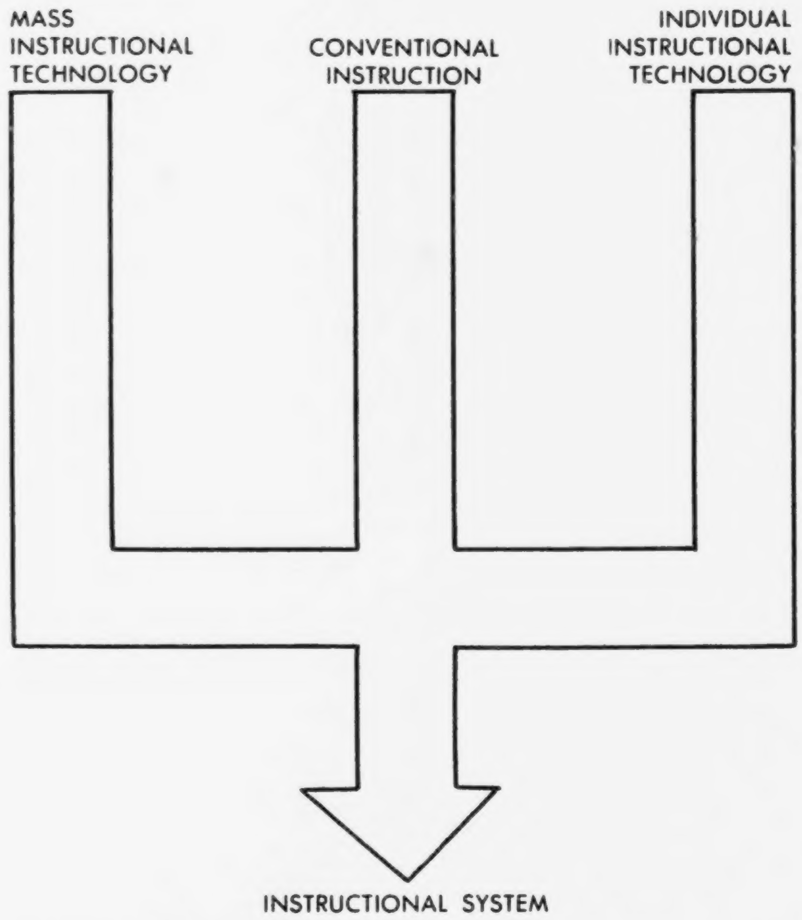

MASS INSTRUCTIONAL TECHNOLOGY
CONVENTIONAL INSTRUCTION
INDIVIDUAL INSTRUCTIONAL TECHNOLOGY
INSTRUCTIONAL SYSTEM

Figure 3—INSTRUCTIONAL SYSTEMS CONCEPT

Actually there are several prototypes of instructional systems in existence. The Zacharias program in physics developed under the sponsorship of the Physical Science Study Committee has some of the earmarks of such a system. In addition to a new textbook built around new content and concepts, there are paperback books for supplementary reading, films, a laboratory manual, and an apparatus manual; and some of the material is now being programmed in both machine and book form. It has been said that the sponsors intend to make other materials, such as filmstrips and tapes. This is, to some degree, programmed by the instructional materials and the teacher's manual into a *system* of teaching physics. Technically, it is not such a system because it has been built atomistically rather than in accordance with the still nonexistent principles of instructional system design. The possibility, however, is there.

This possibility leads us far out into the realm of prediction. Figure 4 introduces the "black-box" concept of instructional systems. If we had much greater knowledge of the instructional system process than we now do, we might be able to set up a black-box system. For purposes of speculation, the instructional process may be broken down into the elements of (1) mass presentation techniques; (2) individual and small-group automated teaching; (3) human interaction; (4) individual study; and (5) creative periods. Assuming a clear understanding of the objectives and content in these elements, and further assuming sufficient hard knowledge about the nature of the instructional processes involved, such a system might be applied to instructional problems.

Information concerning the nature of the students, the specific objectives and content, and the like would be supplied to the teacher-designer, who

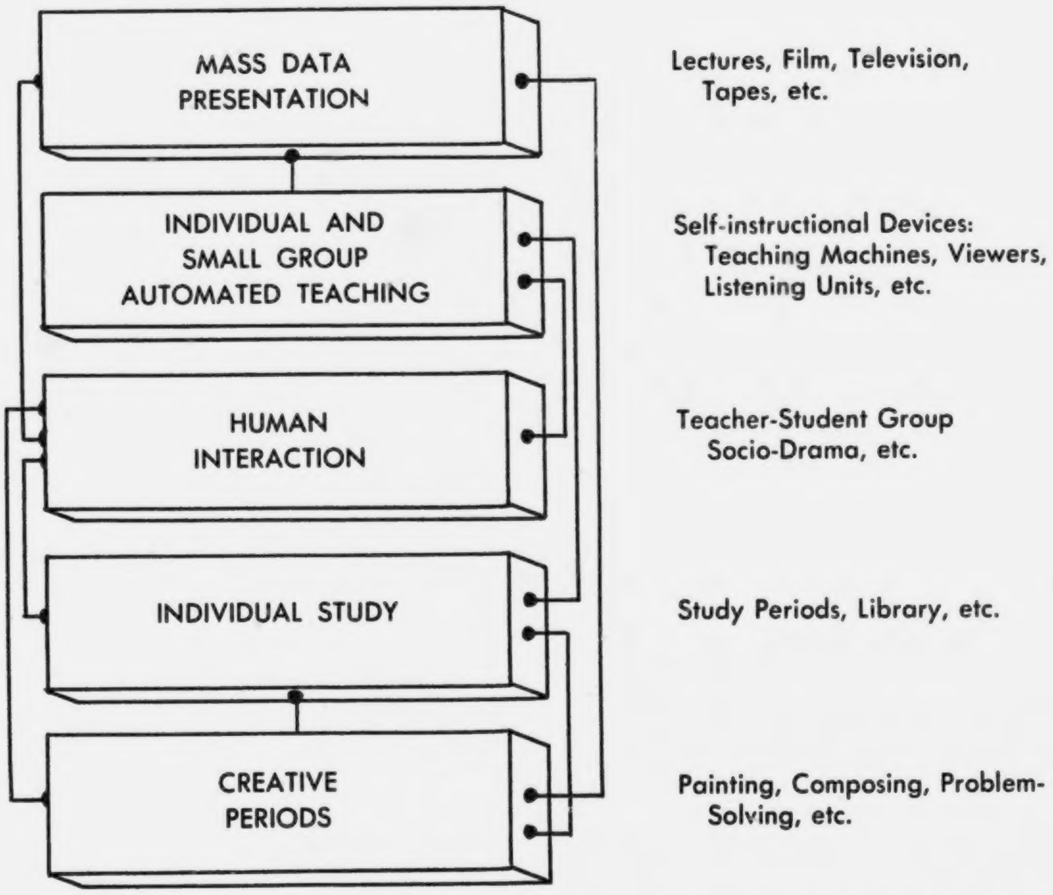

MASS DATA PRESENTATION
Lectures, Film, Television, Tapes, etc.
INDIVIDUAL AND SMALL GROUP AUTOMATED TEACHING
Self-instructional Devices: Teaching Machines, Viewers, Listening Units, etc.
HUMAN INTERACTION
Teacher-Student Group Socio-Drama, etc.
INDIVIDUAL STUDY
Study Periods, Library, etc.
CREATIVE PERIODS
Painting, Composing, Problem-Solving, etc.

Figure 4—INSTRUCTIONAL SYSTEMS—BLACK BOX CONCEPT

would decide which black box would be inserted into the system at a certain point and which subsystem would be traded for another in the interests of the students, the facilities, the cost, and so on. An instructional system would thus have been designed.

It can be argued that this is what the teacher does every day at the present time; but such an argument, while containing an element of truth, actually does not cover the situation, for we are talking about two different approaches to teaching.

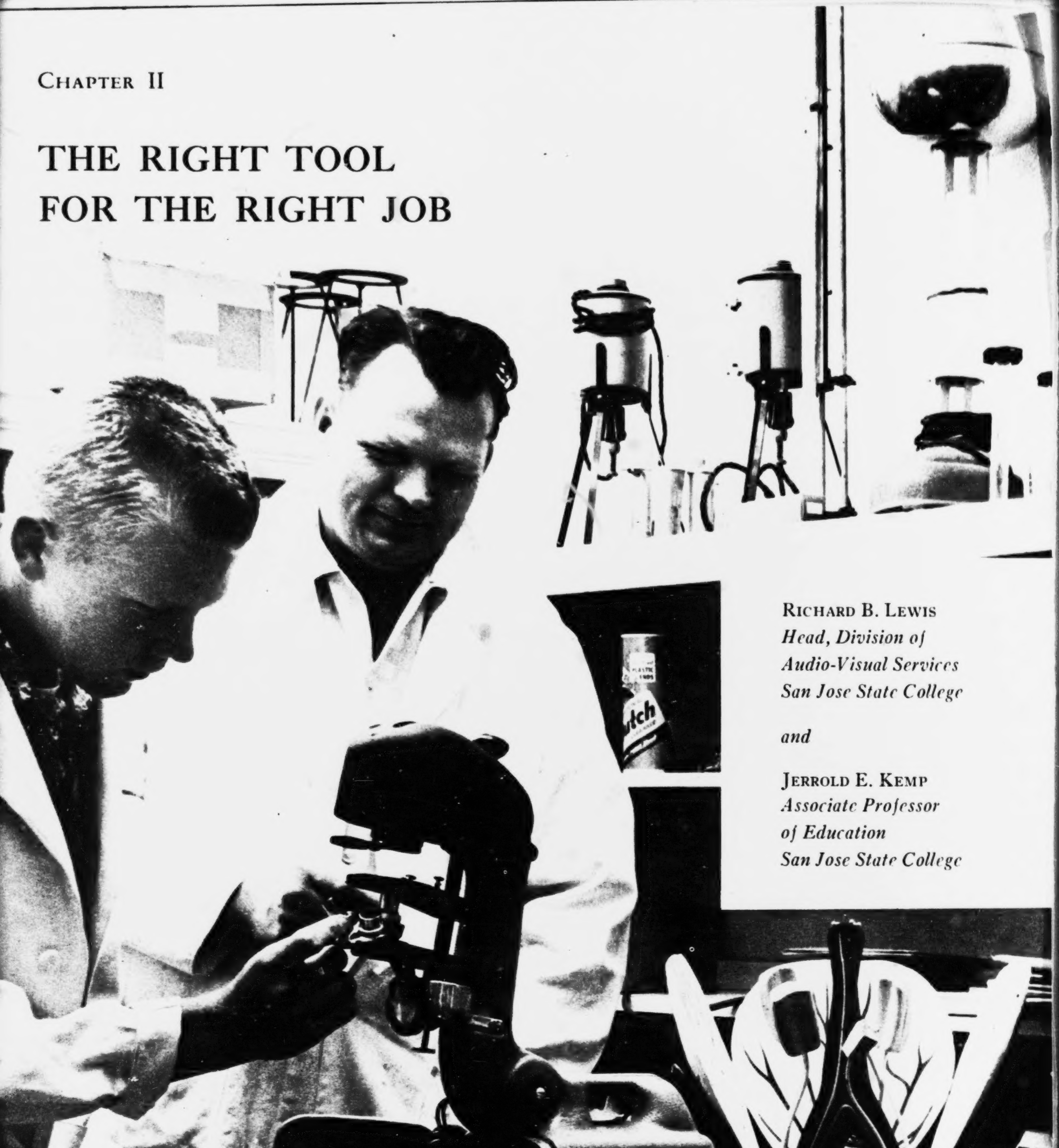
Speculation about the possibilities of instructional systems by no means exhausts the discussion about the potential trends and growth of a technology of instruction. We have not touched, for example, on the conceivable role of computers, data-processing in general, and the new possibilities of storage, retrieval, and display of complex information.

Enough, however, has been said to back up the thesis that a technological revolution promises to engulf education. I use the word "promises" deliberately instead of the threadbare fear word, "threatens." For it is only by this promise of the application of technology to education that I feel we have a chance to make the necessary educational contribution to the solution of our difficult and exasperating national problems. In doing so, the American educational profession not only can retain its vital leadership but also can become, with the aid of the new technology, a true profession with a promise of much greater service to the American people.

Operating as high level professionals, American teachers and administrators need never fear that machines will replace teachers; as the wielders of the new technology, the profession can use it to defend and extend the essential humanity of education. As for control—until someone changes the roles, control still rests with the people, guided well, we hope, by intelligent, high-level professional advice.

Chapter II

THE RIGHT TOOL FOR THE RIGHT JOB



Richard B. Lewis
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and

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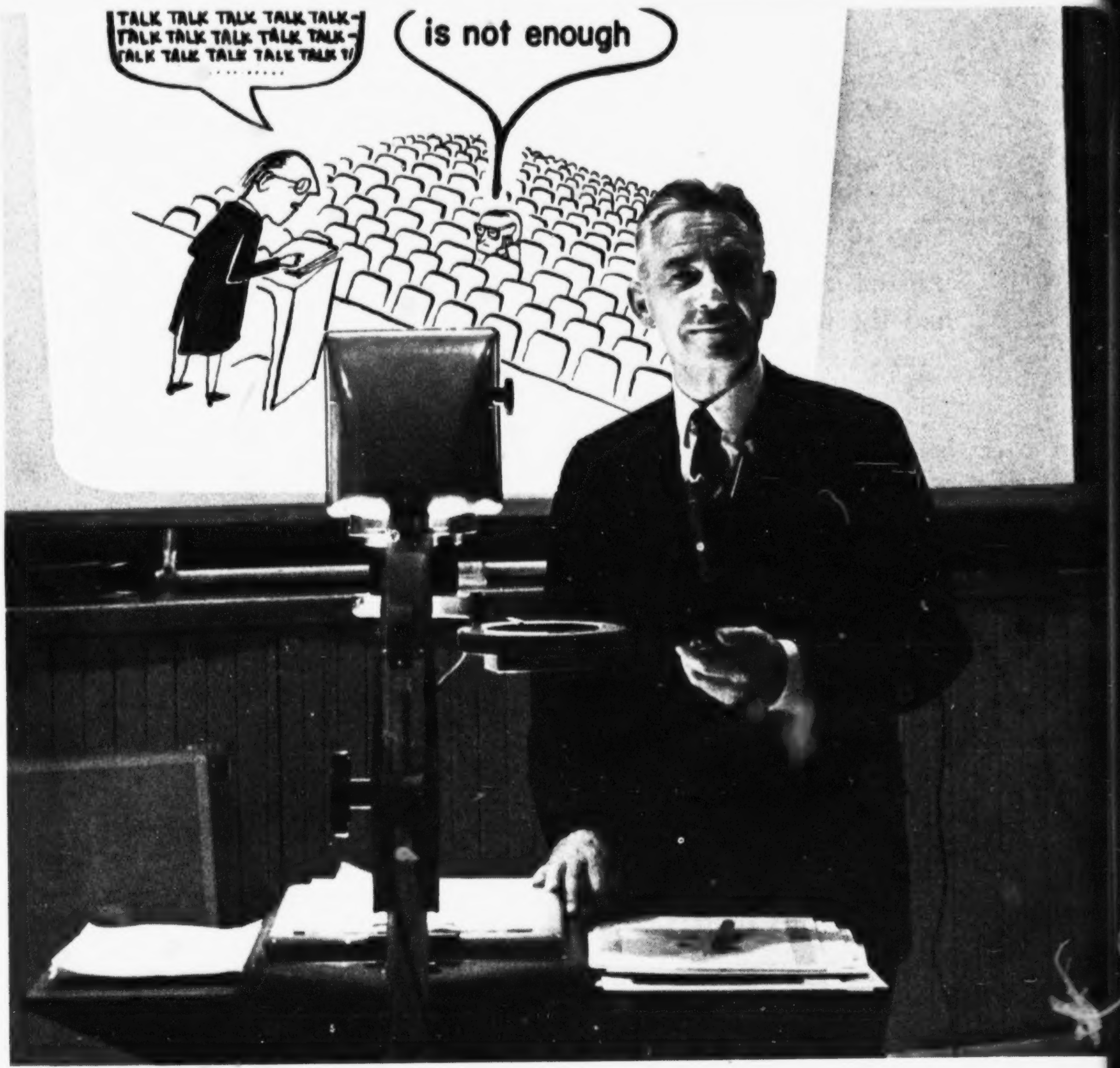
San Jose State College


TALK TALK TALK TALK TALK-
TALK TALK TALK TALK TALK-
TALK TALK TALK TALK TALK !!
is not enough

A major responsibility of education is to provide effective means by which students may learn. Contemporary developments in both psychological research and in technological invention facilitate the adoption of improved methods of teaching and of learning. New methods of instruction are essential because traditional methods do not meet present needs. New methods are needed particularly because of the following developments:

The ever-increasing amount of information to be learned

The need for greater efficiency because of increased numbers of persons to educate with heterogeneous backgrounds and abilities

The new information gained about how we learn, with its emphasis on sensory experiences

The known limitations of exclusively verbal communications in learning

The new concepts of curriculum content (organization) and the place of instructional materials in the educational program

The need for variety and reality in school experiences

The changes in the instructional process that have resulted from new technological developments in media of communication

Effective teachers know that there is no method of teaching that is best for all learners or for use in all situations. They also know the importance of employing in each situation appropriate instructional materials and of having proper working conditions and the equipment required for making the best use of the instructional materials.

A wide variety of media may be used to advantage in providing classroom instruction. Knowing these media and their characteristics permits the teacher to select for each purpose the ones that may be used to best advantage and to plan how they may be used to secure the desired results. Certain information teachers need as a basis for choosing the media that may be used most advantageously for various purposes is presented in the following sections.

Simple Nonprojected Materials

Of the numerous types of nonprojected materials utilized in today's schools, the flannel or felt board and the magnetic chalkboard are of particular interest.

el muchacho
pájaro
perro

Flannel (Felt) Board

The flannel or felt board has a surface that is covered with flannel or felt material. Upon this surface, felt cutouts and various display items that are backed with flannel, felt, or sandpaper readily adhere; the items can be shifted easily from one position to another, and items can be replaced without disturbing other parts of a display.

This type of display board is helpful in the classroom because (1) materials to be displayed on it are easily prepared by the teacher or by the student; (2) information on many topics and at all grade levels may be presented step by step, and in this way the attention of the students is captured and held; and (3) through the handling and placing of display materials, students participate in meaningful learning activity.

Magnetic Chalkboard

The magnetic chalkboard, a large, flat piece of metal, painted as a chalkboard, holds paper materials through the use of small magnets, and heavier display materials backed with magnets will also readily adhere to the boards. The materials can be easily shifted from one position to another, and chalk marks may be drawn or erased as required.

This type of display board is useful in the classroom because (1) all the advantages of the flannel board are inherent in the magnetic board; (2) presentations on a magnetic board are likely to surpass those on a flannel board since the holding power of magnets is greater than that of flannel; (3) captions may be drawn or printed directly on the chalkboard; and (4) magnets are inexpensive, reusable, and easily applied.

SIMPLE PROJECTED MATERIALS

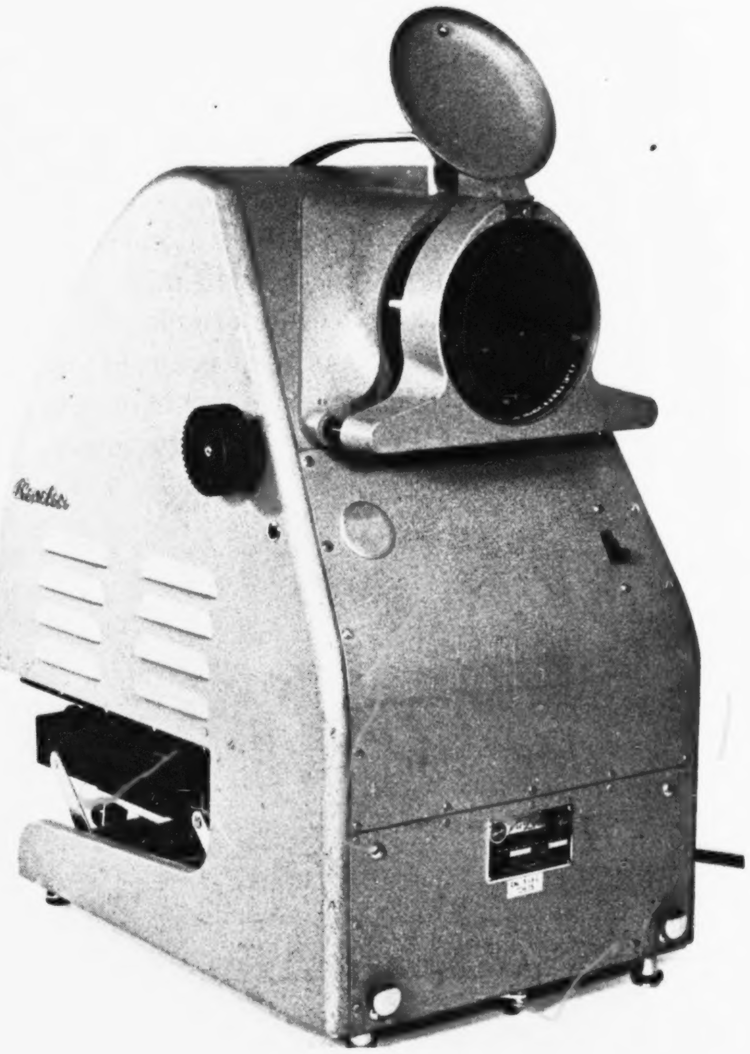
Simple projected materials that warrant attention include the opaque projector, the 2″-x-2″ slide projector, the 35-mm filmstrip projector, the overhead projector, the tape recorder, and the record player.

OPAQUE PROJECTOR

The opaque projector uses the principle of reflected light to make large-scale projections of materials in their natural color and appearance. Single sheets of printed matter, mounted pictures, magazines and book illustrations, and small three-dimensional objects are among the variety of materials that may be projected in this way.

Advantages in using this type of equipment include the following: (1) materials require little or no preparation prior to use in the projector; (2) a number of different types of materials may be readily and easily projected for classroom examination and discussion; and (3) small drawings and pictures may be projected onto a chalkboard, charts, or other surface and traced for certain instructional purposes.

Recent improvements in the design of opaque projectors include reduction in overall size so that the same types of materials can be handled more conveniently than was the case with earlier models. It is still necessary, however, to darken the room to some extent.



SLIDE PROJECTOR (2″-x-2″)

The 2″-x-2″ slide projector is a small device that projects slides made from 35-mm black and white or color films, each mounted in a square frame. This projector may be operated either by hand or by remote control.

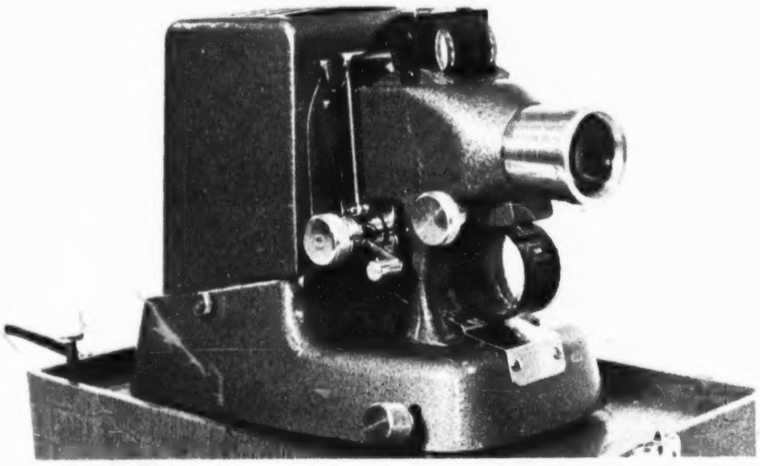
The slide projector has been found useful for the following reasons: (1) series of color slides may be made with comparative ease with amateur camera equipment (regular or high-speed color films are mounted ready for use when returned from a processing laboratory); (2) slide sets may pertain to a wide variety of subjects, functions, and materials—for example, community resource topics, class activities, records of student projects, and copies of printed materials of all kinds; and (3) the arrangement of slides is a flexible process that permits convenient selection and rearrangement for different instructional purposes.

During a showing of slides, care must be taken to ensure that the slides are in correct order and in correct position.

FILMSTRIP PROJECTOR (35MM)

The 35-mm filmstrip projector is a small machine that uses a series of still pictures (generally with titles and captions) placed in sequential order on strips of 35-mm black and white or color film.

Features that favor this type of projector include the following: (1) inexpensive, commercially produced filmstrips are available on many topics, and each is accompanied by a teacher's study guide to encourage good utilization of the strips; (2) filmstrips are compact, easy to handle, and adaptable either for individual study or for group viewing; and (3) the projection of filmstrip can be paced at a rate consistent with the needs of the viewers, thus permitting whatever discussion and active student participation are called for in the learning activity.



Unlike slides, filmstrips are inflexible for the obvious reason that no rearrangement of pictures is possible. Moreover, filmstrips generally permit less teacher control of content and organization than locally produced slide sets.

OVERHEAD PROJECTOR

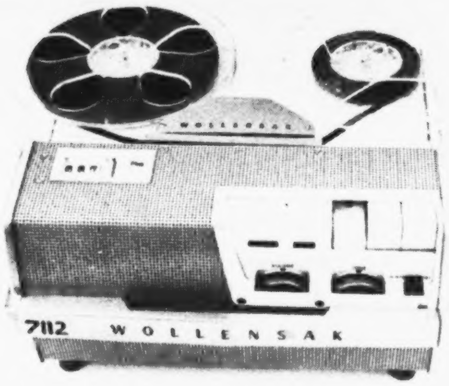
The overhead projector is a device that is used to project transparencies. It is placed near the front of the classroom, and the teacher faces the students as he handles the transparencies and regulates the projector.

Each transparency, laid flat on a glass tray or shelf, is enlarged, reflected, and projected by an overhead "gooseneck" extension containing a mirror-and-lens assembly. The projector's base box contains powerful lighting apparatus and a wide reflector. By means of this equipment, the image of the transparency, thrown upon the screen, chalkboard, or wall, is large, bright, and very clear.

Transparencies may be in the form of individual acetate sheets, or they may consist of clear cellophane that is rolled across the glass plate by means of a crank-and-roller assembly.

The use of the overhead projector permits a process of overlaying—that is, other transparencies with markings or data additional to those on the basic transparency can be superimposed on the latter; each overlay sheet is reproduced clearly on the screen.

Among the advantages that are found in using this device are the following: (1) the overhead projector is particularly well suited for presentations to large groups; (2) because the image thrown on the screen is vivid and finely detailed, it is easily viewed in the classroom under normal lighting conditions; (3) difficult concepts may be presented through step-by-step disclosure or by the addition of overlay sheets to the base transparency; (4) a variety of techniques may be used in the local preparation of black



and white or color transparencies—hand-drawing, heat-processing, photocopying, photography, diazo process, and the like; (5) although audio-visual specialists or production assistants often create transparent materials, students and teachers are encouraged to do so; (6) during a showing, certain effects of movement may be accomplished by the interplay of overlay sheets; (7) while using the projector, the teacher has the advantage of standing in front of the class in the usual manner; and (8) the teacher may conveniently point to various parts of a transparency by using a pencil or other pointer on the transparency itself as he faces the students, the point being reproduced clearly on the screen.

TAPE RECORDER AND RECORD PLAYER

Small, compact tape recorders permit the recording of the human voice, instrumentation, and other sounds originating from many sources. The sounds are recorded on magnetic tape for repeated playback. Modern record players have high fidelity characteristics; modern phonograph recordings are of unbreakable material and are produced at long-playing speeds (33⅓ rpm and 16 rpm) and an intermediate speed (45 rpm). Most players are equipped to accommodate also the 78 rpm speed in order to meet an occasional classroom need for the earlier type of "standard" disc. In some instances classroom record players are accompanied by or combined with recording apparatus.

Because both of these devices contain delicate and intricate working parts, it is important that the persons operating them, whether students, teachers, or other personnel, be sufficiently trained to handle them with care and efficiency.

Tape recorders and record players can be assets to the classroom because (1) a variety of useful dramatic and informational programs, available in most subject areas, can be recorded on tape or disc either locally or commercially; (2) many good tapes and record albums are available from music shops and from commercial firms specializing in educational materials; (3) numerous uses for tape recorders include the preparation of student reports, the conducting of interviews, drill exercises, information on record-keeping, practice in language arts and in foreign languages, dramatization, and self-evaluation of presentations; and (4) phonograph recordings may be used both for instruction and for practice, may be assigned for individual listening, may be heard by the class as a whole, and may be used to advantage in a number of other ways.

COMBINATION USES OF AUDIO-VISUAL MEDIA

Using certain audio-visual media in combination is often helpful in the instructional program. Several of these combinations are described in the sections that follow.

THE 2"-X-2" SLIDES AND TAPE RECORDINGS

The 2"-x-2" slide projector and the tape recorder may be used effectively in combination; for example, the showing of a locally produced slide series may be accompanied by tape-recorded narration. The conventional type of slide projector with a manual slide changer can be used with any tape recorder. In this instance the slides must be sychronized manually with the recording. Automatic synchronization can be achieved by means of an automatic slide changer that uses an inaudible electronic signal from the tape recorder to change the slides at predetermined points in the narration.

WARM AIR
CIRRUS
CIRROSTRATUS
ALTOSTRATUS
COLD AIR
ARM FRONT

Benefits realized from this type of combination include the following: (1) communication is generally more effective than when either medium is used alone; (2) student-prepared projects, as well as carefully designed teacher-made materials, may be presented satisfactorily to groups of all sizes; and (3) the combination is particularly useful when repeated showings with the same materials are required.

Overhead Transparencies and 2″-x-2″ Slides

The overhead projector and the 2″-x-2″ slide projector may be used advantageously in combination; for example, transparencies that show general outlines or diagrams may be projected at the same time as 2″-x-2″ slides that show details, applications, or examples relating to the subject at hand. Utilizing the combined operations of these two projectors with maximum effectiveness calls for (1) careful planning as to what is to be shown; and (2) skillful coordination of projectors and screens to ensure good results.

This combination has many worthwhile applications when general principles illustrated by one projector need to be given concrete meaning through details illustrated by the other.

Moving Pictures with Sound

Results of educational research have shown that when moving pictures are combined with sound for certain instructional purposes, particularly effective learning takes place. When a film-sound combination is utilized in the instructional program, the 16-mm motion picture projector is the equipment that is generally used for this purpose.

Moving pictures with sound (1) constitute a particularly useful communications medium when movement and relationships are important in the presentation of a topic; and (2) permit the use of certain techniques, such as slow or accelerated motion, great magnification, special effects, and animation, for the purpose of clarifying complex concepts.

Because the film-sound combination is less teacher-controlled than other combined media or than single media, it is recommended that (1) class preparation prior to its use be as thorough as possible; (2) the students pay close attention to the film when it is being shown and do whatever notetaking may be deemed advisable; and (3) a follow-up discussion and study be conducted after the showing.

NEW DEVELOPMENTS

New developments have been and are being made continually in the field of communications media. Several of the more important ones as they relate to classroom instruction are considered here.

THE 8-MM MOTION PICTURE FILM WITH SOUND

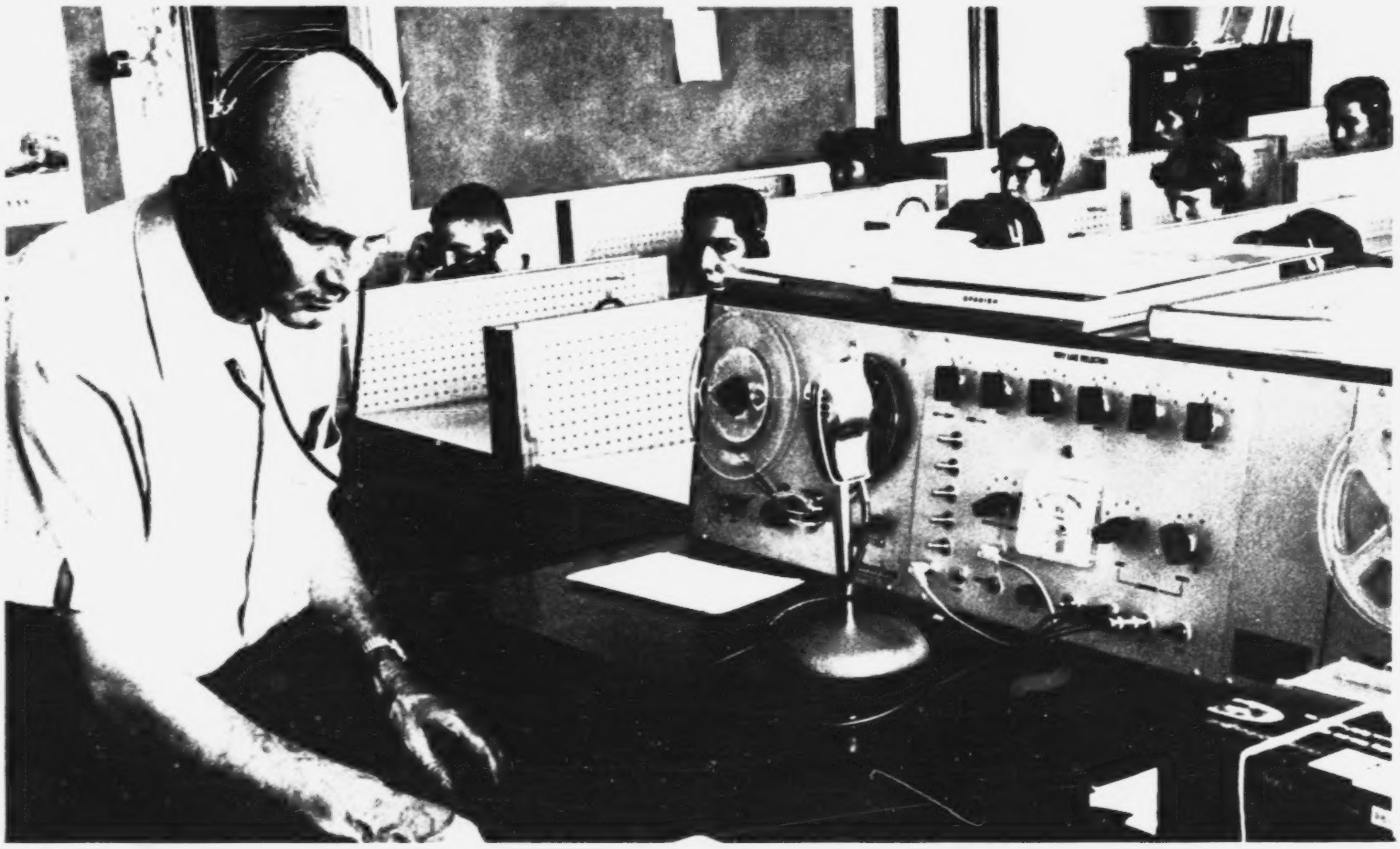
An 8-mm motion picture sound projector is now available. Incorporated in the 8-mm film is a narrow magnetic strip that permits the recording of certain sound features, such as narration. It is also possible for certain 16-mm films with lip synchronization to be reduced in size and used in the 8-mm sound projector.

This type of projector is of value to classroom instruction because (1) it opens up numerous possibilities for the local preparation of films with audio features by supervisors, teachers, and students; (2) it permits the adaptation of many features contained in the 16-mm motion picture medium; (3) the cost of materials and equipment in the preparation of 8-mm film-sound projects is comparatively low; and (4) the projector is particularly suitable for use with small groups of students or for use by individuals for self-instruction.

TELEVISION

The value of television as an educational medium of communication has been widely demonstrated. Continuous research, experimentation, and new approaches are being carried out to insure its best possible usage in the nation's schools.

Among the advantages in using television for instructional purposes are the following: (1) it is a flexible means of transmitting live activities to groups of any size; (2) a variety of techniques as well as other communication media can be incorporated within this medium; (3) closed-circuit programming brings to classrooms television that is tailored to local needs; (4) relatively inexpensive, simply operated TV equipment, consisting of cameras and receivers connected by cable, can be used in the classroom to demonstrate hard-to-see operations, to enlarge small objects, and to accomplish other objectives involving considerable detail; and (5) broadcast or open-circuit television makes available a wide variety of special and general educational programs for classroom and home viewing.



LANGUAGE LABORATORIES

The language laboratory is becoming an increasingly valuable aid to classroom instruction. Essentially it involves the installation of electronic equipment that is centrally monitored by the teacher and by means of which each student develops language skills through recording and hearing his own voice, hearing prerecorded instructional material, and receiving individual guidance from the teacher. With this equipment the student is able to repeat, to respond, and to listen to his recorded replies.

Ways in which this type of equipment benefits learning include the following: (1) it provides opportunity to use effective practical methods in the teaching of foreign languages; (2) it calls for active student participation on an individual basis; (3) it may be used on any of three levels—student listening, student hearing and repeating, or student hearing and responding; and (4) its facilities may be utilized for other instructional purposes, such as music appreciation, shorthand and typing dictation, and arithmetic drills.

The most recent developments in the field of educational media involve aids to self-instruction, which are variously known as programmed learning, learning through teaching machines, or auto-instruction. Self-instruction involves carefully written or programmed materials that (1) direct learning through the presentation of small increments of information; and (2) give the student continual opportunity to test his own learning. Although these developments are generally still in experimental stages, certain programs hold out considerable promise for self-instruction methods.

Programming may be accomplished through a variety of ways—for example, presented as printed material or presented by means of mechanical or electromechanical devices.

Self-instruction equipment and materials have been found to benefit learning for a number of reasons, including the following: (1) the student is required to participate actively in the learning process; (2) the student experiences immediate knowledge of results; and (3) there is increased opportunity for reinforcement of learning.

CONCLUSION

The number of instructional materials now available to the schools, as well as the range of different types of materials, is great. Teachers, specialists, supervisors, and administrators in California school districts can expect increasing development of new resources and refinements of existing ones in the years just ahead.

While it is important to become familiar with the various types of materials and devices that are available and the uses to which they may be put, it is equally important that each type be evaluated from the standpoint of its suitability and appropriateness for a particular instructional program. Not all instructional materials are equally effective in a given situation. In each instance the selection of materials and equipment should be made with a view to their potential effectiveness. The selection should be based on subject content to be covered, instructional objectives, skills and aptitudes of the teacher, grade level and learning abilities of the students, and the particular school situation in which the materials and equipment are to be used. Once the choice is made and the instructional materials have been acquired, the instructional personnel who will be handling them should become thoroughly proficient in their use.

CHAPTER III

OVERHEAD AND OPAQUE PROJECTORS:

Their Use in Mathematics, Science, and Modern Foreign Languages

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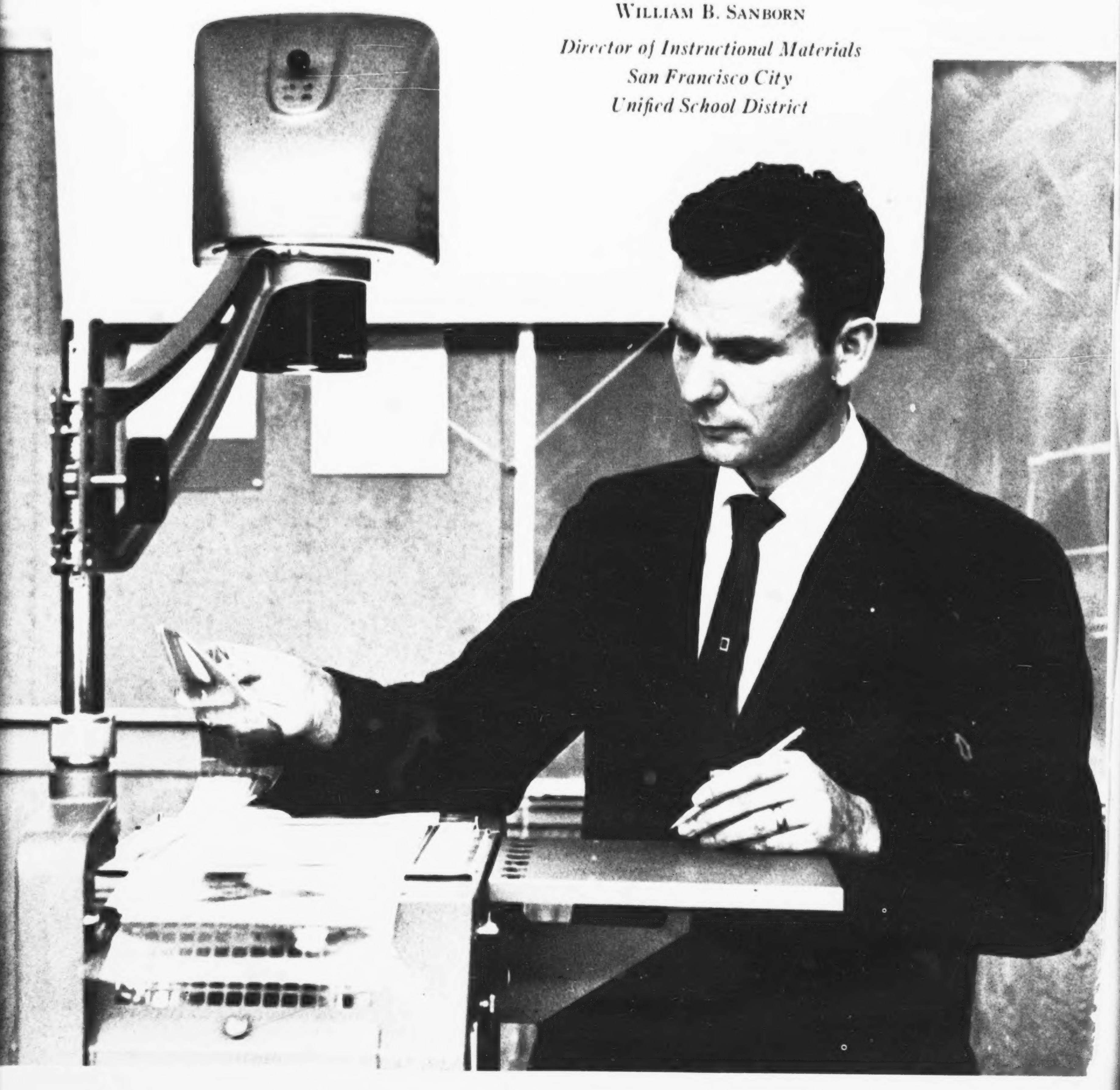
Unified School District



Perhaps no instructional equipment in the field of audio-visual education has been the subject of more undeserved stereotyping, misunderstanding, and unimaginative treatment than overhead and opaque projectors.

In terms of versatility and creativity, it is difficult to surpass the roles that these projectors can play in the classroom. This is particularly true of the overhead projector, which lends itself to a wide variety of practical school uses. The everyday applications that are being made of these devices in the fields of mathematics, science, and foreign language are quite remarkable; and, of course, equally valuable applications might also be made of them in other fields.

THE OVERHEAD PROJECTOR

The overhead projector is now receiving the long-overdue attention it has deserved. It seems to be coming of age as an increasing number of people recognize its versatility. For several years, as a matter of fact, overhead projectors have been used by business, industry, and the armed forces to a far greater extent than by schools and colleges.

CHARACTERISTICS OF THE OVERHEAD PROJECTOR

Essentially, the overhead projector handles a variety of transparent materials and devices. However, it differs radically from any other type of projector. It operates in the front of the room, adjacent to the teacher's desk, and projects a large brilliant image on the screen or wall immediately behind the teacher. This location yields advantages since it enables the teacher to keep in constant eye contact with the class as materials are developed or manipulated. Moreover, the projector can operate with a high degree of efficiency in a room that is not equipped with darkening facilities; it can function acceptably merely when the lights have been turned off. The light output of a modern overhead projector is something that must be seen to be appreciated.

The operation of this machine is simplicity itself. One switch turns on both the fan and the light. Correct focus is achieved by turning a knob, and the screen is correctly orientated by maneuvering a device in the projection head or by elevating the front of the projector.

The overhead projector provides the teacher with an illuminated glass plate that constitutes a writing surface, the dimensions of which are either 7″ x 7″ or 10″ x 10″. The projector employs a roll of clear cellophane or sheets of transparent or colored acetate upon which the teacher can either write during the class development of a lesson or prepare materials and illustrations prior to class sessions.

The cellophane roll is moved by small cranks at the front and back of the glass writing plate. When the illuminated space on the cellophane is used up, additional space is supplied as needed simply by rolling the cellophane to expose a clear writing surface. In the foreign language field especially, many benefits may be derived from this roller process.

Overheads equipped with special masking adapters may also be used to project slides and filmstrips.

TEACHER-PREPARED MATERIALS

The overhead projector may be used by the teacher to present anything normally shown on the chalkboard. Hundreds of different types of prepared illustrations, problems, formulas, notes, outlines, graphs, assignments, reviews, or tests can be handled in this manner. Also, by using special carbons, materials can be typed on an acetate sheet for projection. Once materials are prepared, they may be kept for future use, reference, or review; or they may be erased from the cellophane roll or acetate sheet with a soft cloth.

A grease pencil that produces a solid black image on the white screen is commonly used by teachers to prepare materials for the overhead projector. However, special semipermanent transparent inks are sometimes used in preparing materials on acetate sheets and cellophane rolls. Specialized equipment that permits the processing of transparencies in a matter of seconds, either in black and white or in color, from original material may also be used to advantage.

USE OF THE PROJECTOR

The overhead projector may be regarded as an efficient enabling device because (1) it provides the teacher with an effective means of illustrating, clarifying, or emphasizing certain concepts that need

special consideration; (2) its operations induce an almost irresistible and compelling focus of attention on what is being presented; and (3) it gives the teacher ample opportunity to be creative in the presentation of materials. In the hands of a skillful teacher, this type of projector is a valuable machine—one that has a very wide range of instructional uses.

In addition to teacher-made materials, there are many excellent commercial transparency series available for use with the overhead projector, especially in classwork involving biology, solid geometry, and elementary science. There is little doubt that an increasing number of commercially produced materials will become available for instructional purposes.

The overhead projector allows the effective use of an overlay technique. By using rectangular or vertical mats to frame an 8″-x-10″ writing area, it is a comparatively simple task to hinge together a series of inked or processed transparencies and to project the transparencies one after the other. In this way it is possible to manipulate an illustration by adding to it or subtracting from it. For example, sequences may be shown of the various climate zones of Mexico, the individual steps in solving a mathematical problem, or a dissection of the human chest cavity. Each overlay may be written upon with a grease pencil during projection for purposes of clarification or additional instruction, and the writing can be wiped off when it is no longer needed.

Two-dimensional Materials

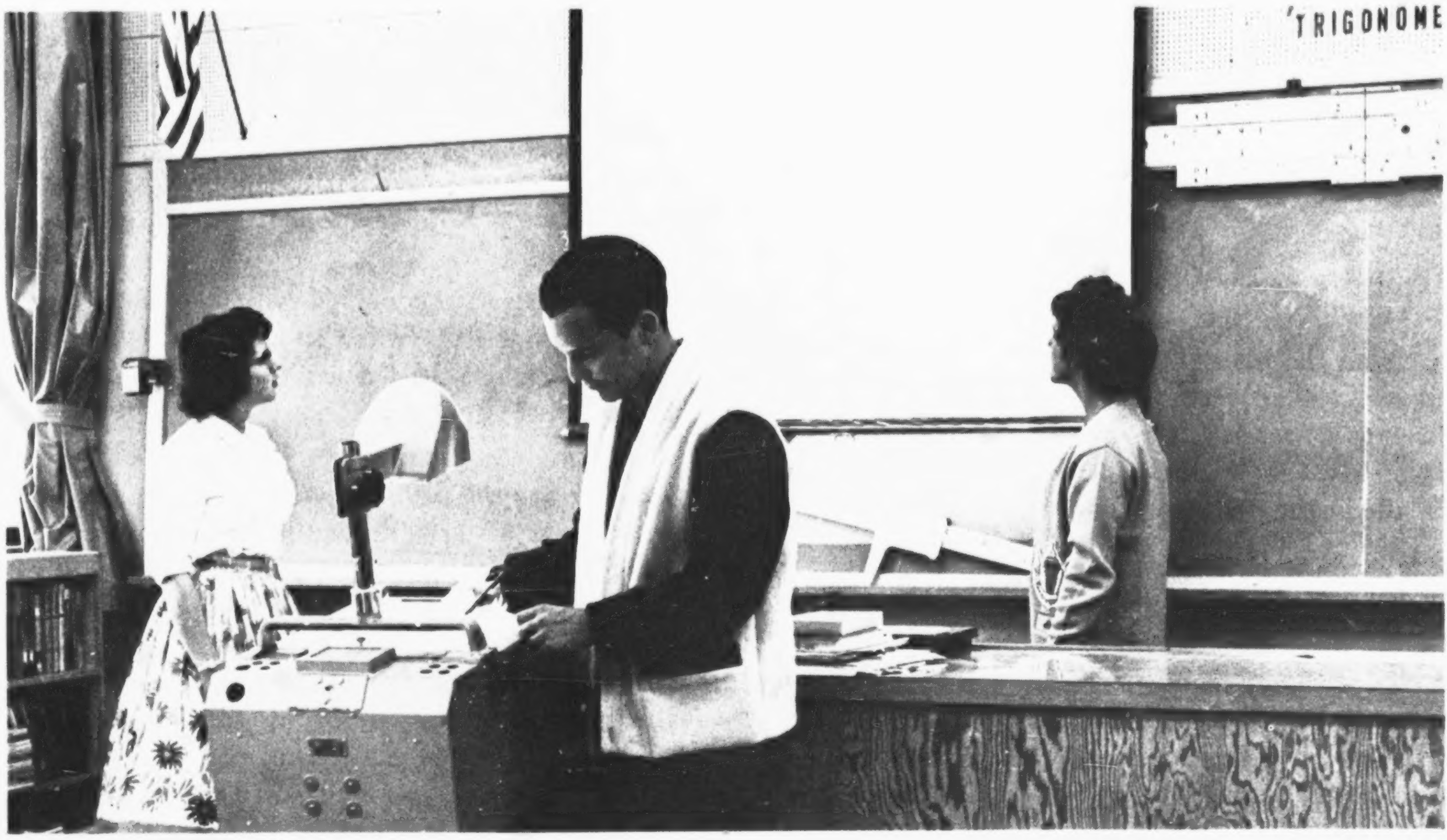
Closely allied to this technique, but somewhat more complicated, is the preparation of two-dimensional, working mechancial models, made from ⅛" to ¼" sheets of heavy colored plastic. The operations of countless mechanisms may be dramatically presented by this method. On the screen, gears can mesh, jet engines can redirect thrust for braking, pumps can intake and exhaust, or the movement of film through a film gate can be shown. Many moving functional operations can be ingeniously demonstrated by the 2-D working model transparency.

New Developments

In recent years various polarizing materials for use with transparencies have become available. A special polarizing device, mounted immediately below the top lens system, revolves at variable speeds. Special polarized transparency materials are affixed to the transparency itself. The combination of the revolving spinner and the polarizing material produces an effect of apparent movement on the screen. This movement may be fast or slow, radiating or pulsing, up or down, left or right, forward or reverse. Seeing a sheet of flat material take on vivid movement on the screen can be a startling experience for an audience of young learners. Electric currents can be shown flowing in one direction and then reversed; water can be shown moving in a diagram; gears can be made to rotate; and many aspects of graphs or outlines can be emphasized in a most dramatic manner.

A number of items that may be used with an overhead projector may be purchased in a dime store or in an office supply house. For example, transparent plastic rulers, geometric figures, and certain biology materials embedded in plastic can be projected quite satisfactorily. Transparent plastic slide rules that are designed for use in the overhead projector are available.

The overhead projector may also be used to show certain nontransparent materials. For example, many demonstrations in biology involve the outline, pattern, or silhouette of an object for identification or comparison. Simple objects such as leaves, shells, and arrowheads can be projected in sharply silhouetted outlines.



A sheet of acetate can be placed over the glass writing area and a bar magnet placed on top. Iron filings sprinkled around the area show the formation of magnetic lines of force. Many such experiments lend themselves to overhead projection.

To take this concept a step further, the overhead's writing area can be used as a "stage" for projecting enlargements of certain microscopic materials. For example, planaria or small fish placed in a petri dish project well; cultures grown in an agar medium may be shown to great advantage; and a teacher-made transparency grid can be used to illustrate measurement of growth and density.

Many experiments suggested in chemistry textbooks can be demonstrated in the overhead with a high degree of success, since an understanding of these experiments depends, in great part, upon the students' observation of some factors of change. To give an example, a petri dish or similar clear-glass container can be filled with boiling water, placed on the "stage" of the overhead, and a sugar cube dropped into the water. As the sugar goes into solution, the rate of solubility and the lines of molecular force that swirl around the cube as it disintegrates may be clearly observed. The numerous experiments that lend themselves to effective presentation by means of the overhead vary from simple to complex; some are particularly colorful and fascinating to observe. Still another advantage lies in the fact that single experiments may be viewed by the entire class.

Projector demonstrations of experiments in physics, biology, or chemistry that use fluids should be done with the writing area or "stage" perfectly flat. Projectors that need their base tilted upward in order to correct keystone and screen orientation are not as versatile as those in which such correction is made at the projector head.

The overhead projector is a type of instrument that should be installed in a classroom or within a given department of a school on a permanent basis. Ideally, it should be as immediately available to the teacher as are chalkboards, maps, and globes. Use of such an instrument can stimulate much creative thinking on behalf of both the teacher and his students.

The Opaque Projector

What can an opaque projector do in the classroom? It can project an almost infinite range of opaque or nearly opaque materials. Among the many items it can project successfully are, for example, an outline map of France, a series of verbs to conjugate, a formula or theorem, a sketch showing scenery for a German play, a color photograph of an Atlas missile in flight, a selection of butterflies or arrowheads, or photographs from the morning newspaper.

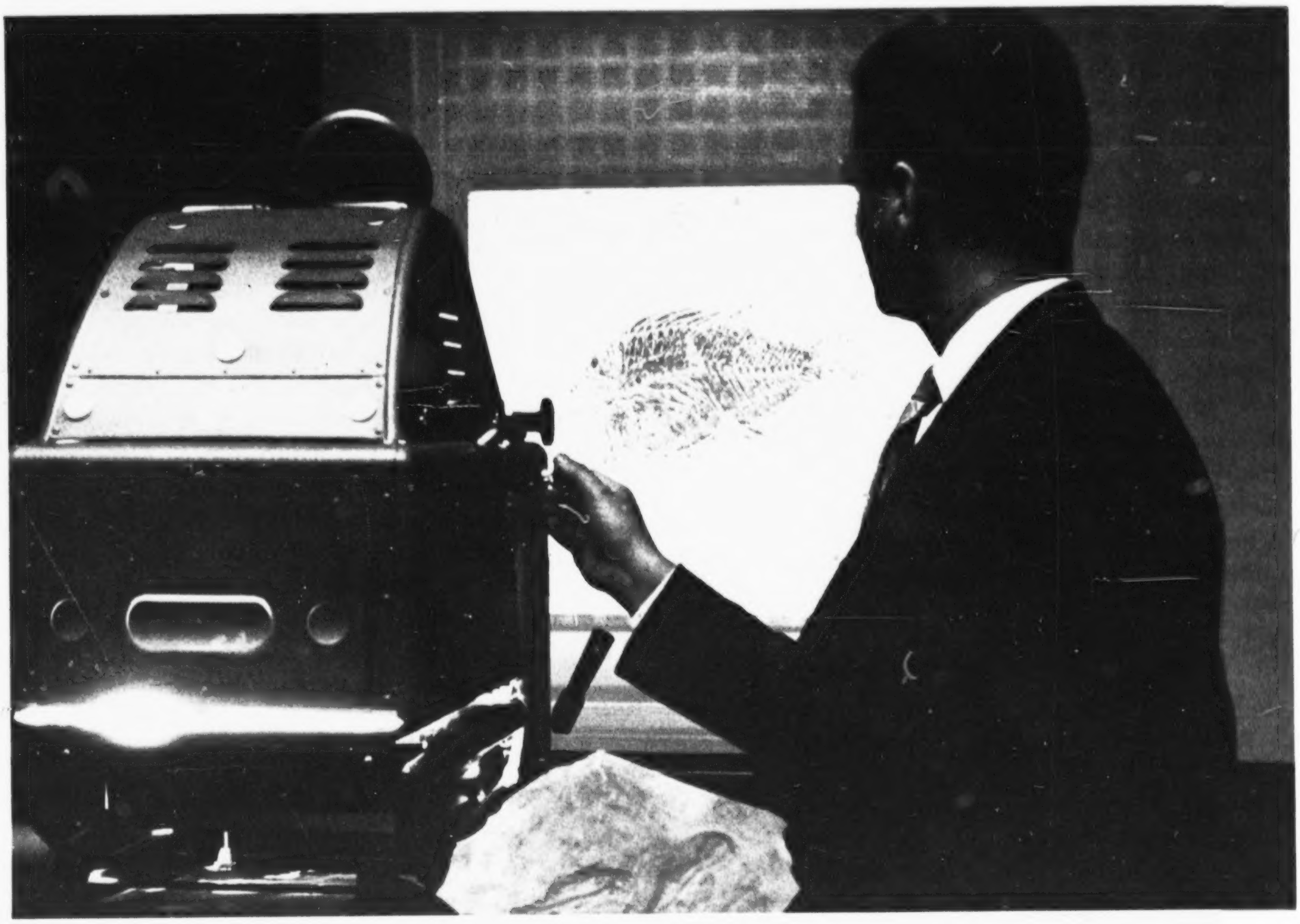
Characteristics of the Opaque Projector

Marked improvements in the design of opaque projectors have been made during the past few years. Current models are simple to operate. Materials are placed in the machine with ease; focusing is uncomplicated; usually one switch turns on both the fan and the light. New opaques run much cooler than their older counterparts, and there is no chance of damaging appropriately mounted material. Most units contain a hand-operated, continuous-belt type of platen that enables materials to be fed semiautomatically into the unit with ease and with no spilling of light. They are also equipped with air-pressure devices that hold copy firmly in place.

The lumen output in current opaques is above that of former models; the size of the machine has been reduced slightly; and there has been considerable reduction in weight. Refinements have been made in projection optics, and most units are available with a variety of lenses. An 18-inch focal-length lens is standard.

Opaques are now equipped with a built-in light pointer. This useful device is a small illuminated arrow that enables the teacher to point to any portion of the projected image.

Basically, the opaque projector permits the teacher to project any flat or semiflat, opaque or nearly opaque material up to 10″ x 10″ in size. It is capable of projecting maps and graphs; printed, typed, or mimeographed pages; portions of books and magazines; photographs, lithographs, and other processed illustrations; small paintings done in various media; a wide variety of small specimens mounted flat; simple collections of minerals and other natural science objects; small pieces or parts made of metal, plastic, or other material; and many



other items. All materials are projected in the same color or colors as in the original. One of the most outstanding advantages of the opaque projector, and yet one that is often overlooked, is that it can be easily used with a great amount of readily available material.

MATERIALS AVAILABLE FOR PROJECTION

Some of the materials that are available for projection are superb color reproductions that appear each month in dozens of publications such as *Arizona Highways* and *National Geographic;* quality illustrations of current interest for classroom use, dealing with subjects that range from cactus plants to the space age; useful graphs of various types, published in countless business, trade, and professional journals and in newspapers; and road and atlas maps, which project very well, as do travel brochures, information leaflets, and guide booklets.

Perhaps no country has so readily available a vast supply of ready-to-use, high-quality illustrative material as does the United States. Teachers find that as they collect materials for the opaque projector and experience its great usability, their interest in collecting increases, and they are able to develop files of excellent materials in a comparatively short time. The possibilities for gathering usable things are practically infinite.

Illustrations in a book or magazine can be projected without being removed from the publication by using a special drawer or glass-plate device with which most opaque projectors are equipped. Also, the teacher can make his own illustrations for the opaque simply by using paper or cardboard and executing his ideas on it in colored pencil, crayon, paint, or felt-marking pen. The opaque handles color very well, and this fact should be kept in mind when materials are prepared.

It is often desirable to mount photographs and magazine illustrations on medium-weight cardboard for efficient use in the opaque. This can be accomplished simply with paste or glue, or by using a dry-mount process. Mounting is recommended for photographic prints because they have a tendency to curl during projection; it is recommended for magazine-type illustrations because the paper, usually quite thin, does not easily stay flat, and unless the surface is uniformly even, the focus may be distorted.

Printed, typed, and mimeographed pages can be used successfully in the opaque projector. However, it should be remembered that when an entire page is greatly enlarged on the screen, the letters remain in the same relative proportion as on the original page. A crowded typed or printed page, therefore, can be quite difficult to read when projected. The fewer the words and the larger the print, the better the projection.

NEW APPLICATIONS

Resourceful effort and a little imagination can enable one to utilize the opaque projector to an extent considerably beyond that of ordinary usage.

Innumerable opportunities exist whereby the opaque can be used to demonstrate a variety of flat materials in the science field. For example, pressed wildflowers mounted on 10″-x-10″ boards or in cellophane-fronted botany envelopes project very well. This is also true of flat materials in the field of biology—fish skeletons, bird skins, small furs, and the like. The technique of mounting and projecting such items can be effective for several purposes, including class observation and class comparison of one specimen with another.

In the field of paleontology, certain interesting materials can be projected to good advantage. This fascinating subject has application from the first contact that grade school children have with fossils to projects carried on in an advanced college class. Some fossil specimens used for instruction may be of the imprint type; and specimens of sandstone, diatomaceous earth, or shale with fossil imprints of fish, scales, leaves, sea shells, insects, or crinoids have good possibilities. Many such specimens project extremely well, and the built-in light pointer aids the instructor in illustrating the essential characteristics of the specimen.

In geology and mineralogy there are numerous possibilities for opaque projection. Any rock, fossil, or mineral specimen that is of a size appropriate for projection may be used. Flat sections of different types of rock may make an interesting opaque series. Cut and polished mineral and fossil forms such as agates, petrified wood, and dinosaur bone may be projected brilliantly by the machine.

Questions often arise regarding the opaque projection of specimens that are flat but too thick—for example, a joined group of quartz crystals with a flat base but with crystals protruding from 1″ to 3″ above the matrix. When any object that is more than ¾″ in depth is projected, distortion of the image may be expected because of the focus required to make all parts of the object equally clear. Some materials that are too thick for projection may have to be cut and prepared in the form of ½-inch slabs. Depending on the facilities available to the school, it is not always possible to prepare specimens for projection by cutting and polishing. However, unpolished specimens can usually be projected satisfactorily, and there are many objects that are flat enough and small enough to be projected without cutting.

Another aspect to the projection of specimen material has to do with the mounting of small items in the Riker mount, which is a flat, glass-topped, cotton-packed box available in a variety of sizes. Items such as butterflies, arrowheads, coins, small fossils, leaves, flowers, single crystals or small groups of crystals, sea shells, and the like can be mounted (1) for individual study; and (2) for class study through opaque projection.

Still another aspect involving the classroom use of specimens is that a large number of specimen materials may be of local origin. There is always a certain degree of intensified interest in materials that are found in the community or surrounding region either by the children or by the instructor, whether they be rocks, grasshoppers, seaweed, plants, or Indian artifacts.

Specimen collections that are of sufficient quality to benefit instruction take on new dimensions and a lively emphasis when they are viewed simultaneously through the medium of the opaque projector. Recognition of the special interests of the students and a willingness to venture imagination and ingenuity are among the ingredients that go into the development of a stock of valuable resource material for use with this equipment.

LIMITATIONS OF USE

Certain limitations involved in the use of the opaque projector certainly do not detract from the overall potential of this type of instrument, but teachers and students should be aware of them. Knowing both the possibilities and the limitations of the instrument means that it will be used to sound advantage.

First of all, this projector accepts only opaque or nearly opaque materials. It will not project transparencies or slides of any type.

Secondly, unlike the overhead projector, the opaque functions best under conditions of maximum darkness. Although recent improvements have been made in the light output of opaques, the fact remains that the darker the room, the better the image. This does not mean, however, that the classroom has to be pitch black. The differential in light output between an overhead and an opaque projector depends upon the light source and the type of material to be projected. The opaque operates by reflecting light into and then from opaque material. The overhead passes light directly through a transparency and through a lens system. The reflected light of opaques gives less illumination than the light from other types of projectors.

Thirdly, the opaque functions from a projection location in the center or rear of the classroom, and the light is thrown a much greater distance compared with that of an overhead, which operates at the front of the room only a few feet from the screen.

Finally, opaque projectors are large and somewhat cumbersome by comparison with smaller types of audio-visual equipment—a limitation, however, that is eclipsed by the inherent values of the instrument.

The National Defense Education Act has done much to focus attention on the many contributions that efficient instructional aids have made and are making to effective classroom instruction. Overhead and opaque projectors have been found to be practical and valuable tools. They should be used realistically and imaginatively by teachers, specialists, students, and others who are actively involved in the instructional program.

CHAPTER IV

NONPROJECTED RESOURCES IN THE TEACHING OF MATHEMATICS, SCIENCE, AND MODERN FOREIGN LANGUAGES IN THE CLASSROOM

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Associate Dean of Students
and Associate Professor of Art
Alameda County State College

The classroom is a workshop composed of many sections, each contributing to the total educational program. The environment of the classroom, therefore, is an important factor in stimulating learning, and the creative teacher must know how to utilize it most effectively.

The classroom should be planned and organized as an inviting place in which to learn. The provisions that are made should help to motivate students, promote their interest in learning, and encourage learning that is meaningful. Within an environment of this type, the creative teacher can stimulate interest in mathematics, science, and foreign language and motivate learning by the wise use of projected and nonprojected materials.

Among the more important nonprojected materials that can be used to advantage in classroom work related to these subject fields are bulletin boards, classroom centers of interest, collections and displays of flat pictures, charts, classroom libraries, and flannel boards and chalkboards.

BULLETIN BOARDS

Bulletin boards constitute an almost indispensable resource for the teaching of mathematics, science, and modern foreign languages. They serve as "visual texts" augmenting regular curriculum areas, provide motivation for students, and assure a ready source of informative material for the class. Bulletin boards may be two- or three-dimensional; they may be simple or elaborate; they are used by both students and teachers.

Bulletin board displays may be constructed from various types of materials, and the rules relating to their use are relatively few. Each display should be provided with an appropriate caption or title to ensure student understanding and to unify the items displayed. Titles and other data may be typed on index cards (sizes ranging from 3″ x 5″ to 5″ x 8″) or handprinted with crayons or chalk on white or colored paper. Cutout letters may also be used; one method is to provide for each letter a template cut from X-ray film.

Careful attention should be given to the special arrangements of bulletin board displays. Crowded information cannot readily be absorbed by the student. The design of each display should provide sufficient blank space to rest the eyes as well as to accentuate the materials displayed. It is generally more feasible, therefore, to provide one clearly expressed presentation of an idea per bulletin board than to attempt to provide several.

Because bulletin boards are usually constructed of cork, composition board, or other semisoft material, small containers such as tack boxes, paper drinking cups, or crayon boxes can be fastened to the board to support certain objects for display. Paper is attached with pins. There is little need to cover the entire board with background material although a few pieces of colored paper may be used for accent. Foreign newspapers used as backgrounds are useful in language studies.

Free and inexpensive bulletin board materials may be obtained from industrial and commercial houses and from national organizations in the fields of mathematics, science, and languages. Many of these firms and organizations publish literature and pictures especially for schools. Interest in mathematics may be heightened by illustrating, for example, the intricacies of electronic digital computation, especially in conjunction with a related display of student papers showing the similarities between higher mathematics and that which is studied at the particular grade level involved. Interest in science may be sharpened by well-illustrated accounts of exploits in the space age. Interest in foreign languages may be promoted by displaying travel folders, magazines, and other materials printed in the language or languages being studied.

Whenever possible, bulletin board projects should be conducted by student committees so that young people may acquire skills in the portrayal of their ideas. Originality alone is not sufficient to justify a display; the project must contribute to learning by communicating some idea or information needed to clarify or implement the classroom instruction. The bulletin board, moreover, does not exist in isolation; it is related to other teaching materials and may serve as an introduction to new units of study as a supplement to existing studies or as a summary of a study just completed.

Book jackets and record album covers may be fastened to bulletin boards to acquaint the class with titles and originators of books and recordings

WHEAT CHEX
CEREAL
CARNE
FRUTA
LECHE

considered pertinent to the subject areas. Teaching a foreign language may be clarified and to some extent simplified when recordings are used in conjunction with displays having to do with idioms, sentence structure, and rules of grammar. Tape recorders, motion picture projectors, and other devices may be placed on a table directly beneath a bulletin board and connected by strings to printed explanations and diagrams on the board.

Bulletin boards should be changed regularly to prevent monotony. It is wise for the teacher to remove and replace one bulletin board at a time rather than attempt to revise the room completely, for the task of creating an entirely new set of bulletin boards for the classroom is a demanding one.

CENTERS OF INTEREST

Centers of interest are sections of the classroom devoted to the display of subject area resources. For example, a center of interest may be simply a table or cabinet that houses a rock collection or an assortment of sea shells; or it may be a shelf full of well-chosen books.

A science center of interest, depending on the grade level, may contain one of many things—an aquarium, growing plants, a geology display, a microscope, a terrarium, or a wide selection of science books and periodicals.

A foreign language center of interest is most effective when it exhibits the language books, arts and

crafts, maps, toys, photographs, and pamphlets that deal with the social, cultural, and linguistic characteristics of the country whose language is under study.

A mathematics center of interest may be used to establish mathematical concepts and functions. This can be done, for instance, with displays that contain pieces of cardboard shaped geometrically, segmented forms illustrating fractions and percentages, an abacus contrasted with a modern calculating machine, and other materials and devices.

All displays should be labeled and titled with sufficient information so that students may readily comprehend their meanings and purposes without the help of the teacher. The skillful use of colored construction paper as a background for titles or as a means of accent or emphasis is likely to make the center an attractive one. Elevating on a box or carton an object that has special significance makes it the focal point of a display and draws attention to the role assigned to it. A simple cardboard box covered with any type of decorative paper may be used for this purpose.

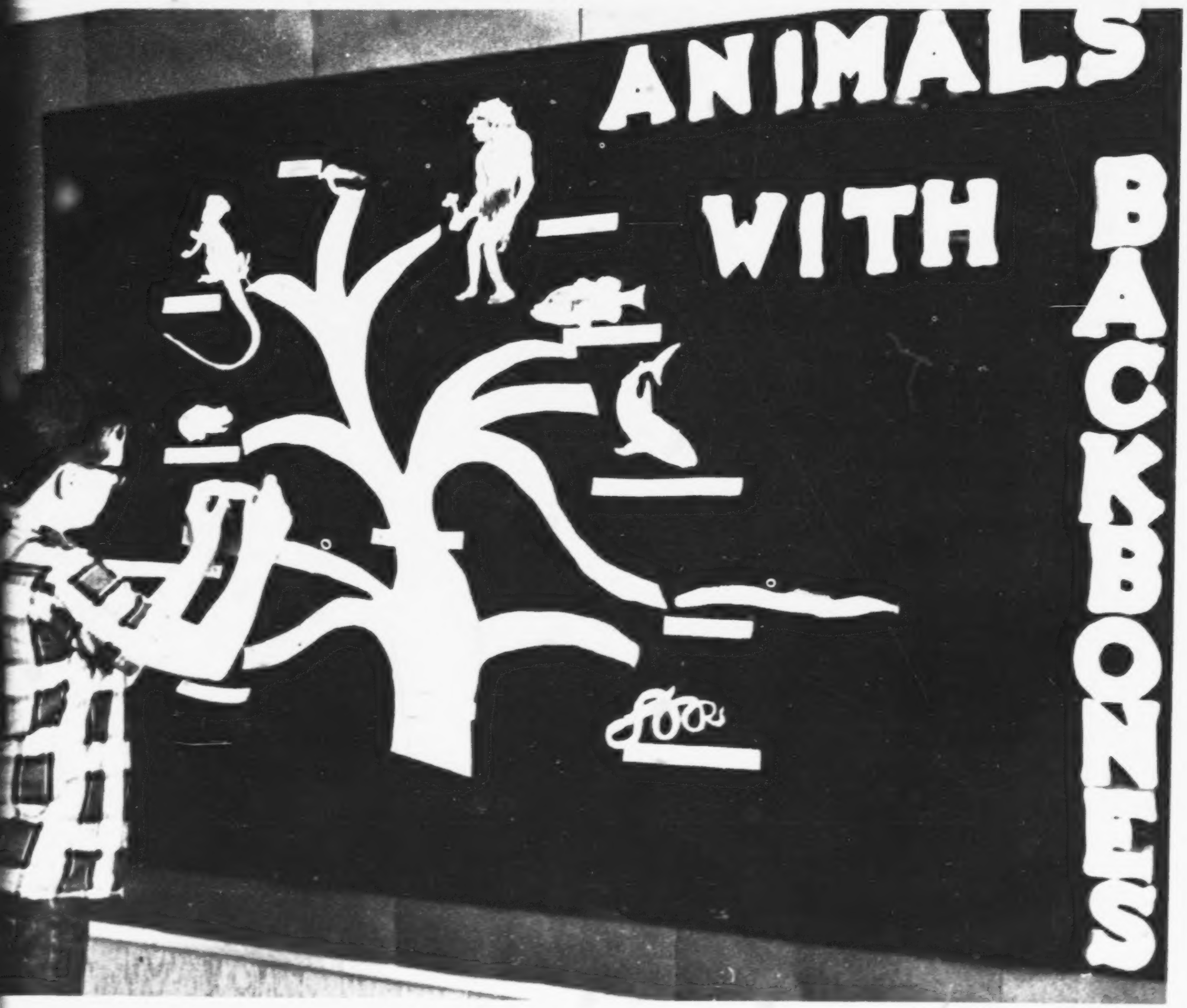
Centers of interest are sometimes composed solely of items that originate outside the classroom. Extensive collections of such items may be gathered during the school year. A large collection of signs, menus, and tourist guides collected by a teacher of German and the members of his class was used to emphasize the practicality and usefulness of that language. Students in a mathematics class arranged displays showing stock market fluctuations, the distribution of the national budget, and the formulation of airplane schedules as illustrations of applied mathematics. The display of a small-scale model steam engine proved as engrossing to adult visitors to a science classroom as it was to the students.

The effectiveness of a center of interest is not dependent upon intricate construction or fancy embellishment. Excessive attention to appearance can easily obscure the purpose. The aim of a display should be that of the best way to communicate the idea behind it; often the best way is the simplest.

FLAT PICTURES

The study of mathematics, science, and foreign languages may be expanded by the classroom use of collections and displays of flat pictures. Pictures of this type offer the advantages of being readily available, easy to store, inexpensive, and related to topics of immediate interest. They may be handled by students in the classroom, studied closely, or taken home for further study.

Flat illustrations are generally easy to obtain. They may be clipped from magazines, newspapers, brochures, and pamphlets published for the general public or for the specific fields of mathematics, science, and foreign languages. Airlines, steamship companies, railroads, travel agencies, foreign consulates, oil concerns, and other agencies publish pictures, posters, pamphlets, and other materials that may be used to advantage for illustrative purposes.


ANIMALS
WITH
BACKBONES

COSAS HEC
EN MEXI

In recent years major magazines have produced color photographs and drawings on such subjects as the evolution of man, the solar system, space travel, the sea, advances in science, developments in mathematics, and the foreign countries whose languages are studied today in American schools. Good photographs of great scientists, mathematicians, or linquists, prominently displayed, motivate students and stimulate their curiosity; folding cardboard easels made by students may be used to display them. Scrapbooks containing flat pictures frequently provide students with rich information related to their interests in science, mathematics, and foreign language.

Pictures cut from magazines should be mounted to ensure permanency, easy handling, and storage. Mounting is a simple process and may be done in numerous ways, the simplest of which is gluing or pasting the picture to a piece of cardboard. Good results may be realized from using rubber cement, casein glue (thinned with a little water), or regular school paste. Dry mounting may be done through the services of the audio-visual department, and dry-mount tissue may be applied with a hot kitchen iron.

Mounted pictures should be trimmed to standard sizes to facilitate storing or filing and should be preserved with a coat of protective spray. A commercial plastic spray provides a mat film; shellac thinned with alcohol may be either sprayed or brushed on. Titles and other pertinent information should be typed on cards and these, in turn, pasted to the backs of the pictures for identification. Pictures should be filed according to subject area. Cardboard cartons make excellent file cases.

CHARTS

At all grade levels charts are a useful means of displaying information. They should be large, easily read, noncluttered, simply lettered, and communicable from some distance away. The teaching of science, mathematics, and foreign language may be facilitated by charts that are illustrated with drawings made directly on the chart surface or with pictures pasted on or attached to them.

Chart paper comes in standard sizes; usually two holes are punched along the top so that it can be

M
GEOMETRI
FW
BP3
MOBILAB

Milk
2 pints
=
1 quart

used with a chart rack. Charts may be lettered with crayon, grease pencil, India ink, or felt-tipped pen, the latter being most suitable for speed and convenience. Most charts are temporary, but some may be used again and should be stored for future projects.

Students may create effective charts in relation to such diverse subjects as the solar system, conjugations of irregular French verbs, and the derivations of equations in mathematics. These charts may be used in combination with other audio-visual materials that amplify the information summarized in the chart.

Charts may be used to illustrate models of engines, airplanes, space ships, submarines, the human eye or heart, or a series of idiomatic expressions in a foreign language. Sequential charts dealing with mathematical concepts, scientific developments, and linguistic processes are valuable classroom resources.

CLASSROOM LIBRARIES

Every classroom should have a library. It may be merely a shelf or a table on which books dealing with subjects currently being studied are displayed, but these books should be readily accessible to students for school and home use. It goes without saying that these and other types of publications making up the classroom library should be of the best possible quality and should be relevant to the subjects under study.

OTHER INSTRUCTIONAL AIDS

The classroom teacher should make every effort to have available in his room a wide variety of nonprojective devices that help to make mathematics, science, and foreign language instruction interesting and absorbing for the students. Many of these resources require no special operating skills.

The teaching of mathematics may be aided, for example, by the use of a flannel board. Learning about addition and subtraction is easier when the student can watch things actually being added or taken away; and learning about fractions is simplified when students see that the division of a pie is actually a fraction problem.

A flannel board may be constructed of plywood or cardboard covered with flannel. Drawn and cutout letters or numerals, illustrations from magazines, and even small objects may be backed with flannel for use on the board. Equally good substitutes for flannel are sandpaper or flocking (available in sprays).

The chalkboard, that ever-present, time-honored, taken-for-granted resource, is a most effective teaching device if it is used properly. Colored chalk adds a new dimension to the chalkboard, especially in illustrating scientific concepts. When lessons are concluded, chalkboard exercises or illustrations that are worth retaining may be transferred to charts or reproduced for display on bulletin boards.

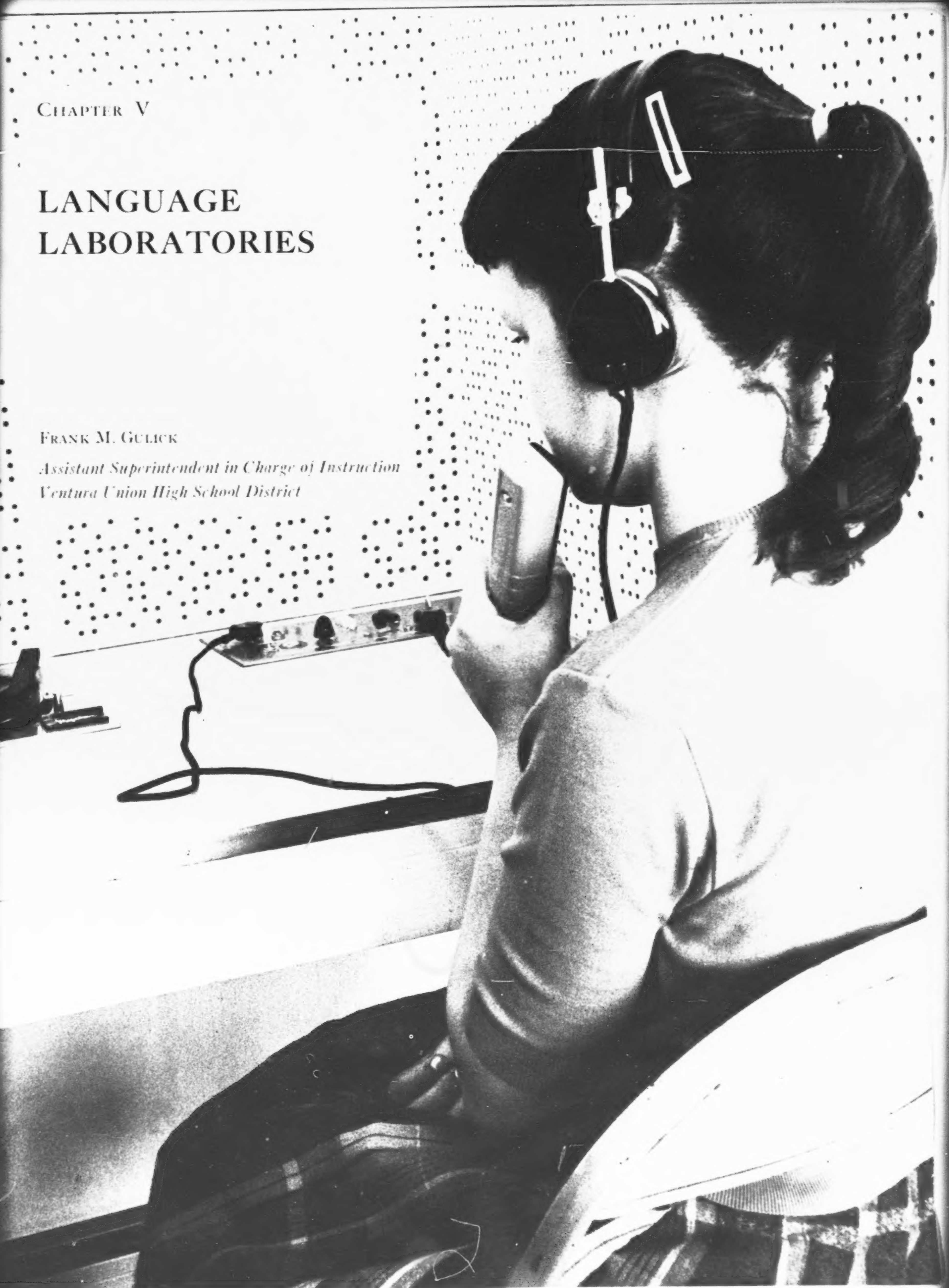
Any nonprojected resource that augments, aids, stimulates, motivates, or brings to the student a new facet of learning is usable. Education in mathematics, science, and foreign languages is being broadened. Each day progress is made in the field of teaching aids. A wise teacher uses them to make wiser children.

CHAPTER V

LANGUAGE LABORATORIES

FRANK M. GULICK

Assistant Superintendent in Charge of Instruction
Ventura Union High School District



The National Defense Education Act, passed in 1958 to strengthen and otherwise improve our national welfare, focused attention on the importance of people of different countries being able to exchange ideas through the use of one another's native tongues. This act made it possible for the schools to introduce a new type of instruction in modern foreign languages to help students develop the language skills required to exchange ideas with people whose native languages are other than English.

In the first two years following the passage of the National Defense Education Act, more than $21,000,000 was spent for new kinds of modern foreign language instructional facilities in the public schools. Half of this expenditure was made from NDEA funds, and half was made from the funds of the school districts that acquired the facilities. The U. S. Office of Education reported early in 1961 that over 2,500 language laboratories were in use in the schools; reports from other sources are to the effect that many more installations will be completed and put into use during 1962.

The experience that the Armed Forces and numerous colleges and high schools in the nation have had with language instruction has borne out the fact that systematic audio-lingual practice activities are highly important in learning to speak a foreign language and that they are particularly important in the beginning phase of language study. This experience has also revealed that electronic and automated language laboratory equipment enables most students to develop language skills to a higher degree of proficiency than would be the case without the equipment.

Language laboratory facilities multiply the opportunities for all students to have (1) regular and frequent oral practice sessions; (2) the individual instruction that is needed; and (3) a wide variety of accurate and realistic lesson material with which to practice. The new facilities are helping an increasing number of students to learn to communicate effectively in a foreign tongue, and these facilities are helping not only those who are academically talented but also those who are of modest or somewhat limited intellectual abilities.

Enrollments in foreign language classes throughout the nation are expanding, particularly at the beginning levels in the secondary school. Instruction in foreign language fundamentals in the elementary school is on the increase, and the pupils are showing much enthusiasm for it. It is apparent, then, that because of the forward strides that are being taken in the field of foreign language instruction and because of the important bearing that language skills have upon the world scene today, language laboratory equipment, facilities, and materials merit serious consideration for regular use in the schools to whatever extent it is possible to use them in each school or school district.

Increasing numbers of secondary school teachers as well as college instructors are taking special summer school training designed to develop skill and understanding in ways of using a language laboratory with maximum effectiveness. NDEA funds provide assistance both to the institutions offering the training and to those who enroll.

The following sections are concerned with the fundamentals, functions, and types of language laboratories; current patterns of laboratory installations; and some guidelines for planning language laboratory facilities.

Fundamentals of Language Laboratories

Prior to any planning that may be done by a school district for the provision of language laboratory facilities, it is important that the following essential information regarding such facilities be clearly understood: basic concepts, elements, functions, purposes, and advantages of language laboratory equipment and materials.

Meaning of the Term "Language Laboratory"

The term "language laboratory" is used to refer generally to a combined installation of certain audiovisual and audio-lingual facilities in which automated and electronic devices, circuits, and materials are used to increase the learning efficiency of students in foreign language classes, particularly in the spoken phase of language instruction.

Essential Elements and Functions of a Language Laboratory

The major function of language laboratory facilities is to help students develop lingual skills by listening to and orally responding to a large number and variety of prerecorded language practice materials. Some of the student's work is done simultaneously with that of the other students in the classroom; all of it, however, is done independently and semiprivately—that is, each student has his own booth and equipment and is not distracted by the practice of others in the room. Another function, depending upon the class or level of equipment used (see Class III, page 40) is to enable students to record and listen to their own voices and to check their own progress.

The principal components of a language laboratory system and the specific functions of each are as follows:

Prerecorded materials for instruction and practice. Prerecorded materials for instruction and practice usually consist of magnetic tapes for use on tape-recording equipment, but some records are still used.

1. Instructional material, planned with great care, is arranged in proper sequence and with proper timing. It is closely related to the other instructional activities that are carried on with the class group.
2. Tapes usually include such exercises as dialogue drills, question-and-answer pairs, pattern practice, conversation practice, and comprehension tests. The sound from the tapes or records should be of high quality.
3. To date much of the prerecorded practice material has been prepared by teachers for use in their own classrooms. The first commercially prepared tapes were merely voiced selections from existing textbooks with the traditional approach; generally they were not satisfactory. Newly available sets of tapes, however, give evidence of careful preparation around established audio-lingual learning principles. Some of these are being prepared by textbook publishers and are closely correlated with the new text materials.
4. Most of the tapes may be purchased at reasonable prices, with textbook publishers often furnishing, without charge, master tapes from which schools may make their own copies.

Instructor's station. The instructor's station is equipped with what is called the "console," which includes the following:

1. Equipment for playing the prerecorded materials and transmitting the sound through appropriate channels to the students. This equipment usually consists of two or more tape players, amplifiers, and level-control devices. Often a record player is included. Distribution facilities usually provide for each channel to be switched (at the console) to all of the students simultaneously or to individual students, as the situation in the practice sessions may require.
2. Equipment for monitoring each student's oral responses (without interrupting him), and for communicating privately with him regarding his work. This equipment includes a switching panel that has a control for each student station so that the teacher can monitor the student's responses and communicate with the student. The controls are numbered to correspond with the student stations in the the room and are usually arranged in a pattern that corresponds with that of the student stations. The instructor's "intercom" unit, consisting of headphones, microphone, and microphone amplifier, is a part of the console equipment.

Student stations. The language laboratory contains units known as student stations. Each such station constitutes an individual laboratory for each student in the class group and should include:

1. A headphone set to enable the student to hear the lesson material and the instructor's voice coming via the sound channel from the instructor's console.
2. A microphone, sometimes hand-held but more often mounted on the student's desk, and a small amplifier. These devices allow the student to hear clearly his own responses as he makes them. They also provide opportunity for the student to monitor all phases of classwork and to be in constant communication with the instructor. The amplifier usually contains student volume-level controls for the incoming lesson material and for the student's voice responses.

3. A "booth," approximately 24″ x 30″, that serves to house the equipment described in the foregoing and semi-isolates the students—acoustically and visually—one from another. Best practice requires that all booths face toward the front of the room so that projected visual materials may be correlated with the taped sound exercises. For this purpose and to ensure eye contact with the instructor, the front of each booth is usually kept open or provided with clear glass.

4. A tape recorder may also be provided for each booth. This should be a dual-track type especially designed so that the student may play a portion of the master lesson on one track and record his own responses on the other. He may then play back both tracks and compare his responses with that of the master voice. He may erase his own responses and then record repeatedly until his performance matches that of the master voice. The recorder also permits each student to progress at his own rate.

ADVANTAGES OF LANGUAGE LABORATORY FACILITIES

The following are among the advantages that are found in the use of language laboratory facilities—either in a room that is utilized altogether as a language laboratory or in a standard-type classroom that uses language laboratory equipment and materials.

Students are able to listen to a greater amount of spoken language material by the use of tape and disc recordings than is possible in a classroom that does not have such equipment. A wider variety of materials can also be made available. Tape recordings prepared by the teacher or by other persons, including natives of the country whose language is being learned, can be accumulated to provide a rich classroom library of spoken materials. These sources lessen the continuous dependence of the students upon the classroom teacher for aural practice and free the teacher for more observation of student reaction and progress.

Students are able to hear the spoken language much more clearly by means of headphones than they would hear it directly from the instructor in the traditional type of group instruction. Moreover, they hear their own responses clearly without the confusion and misunderstanding that sometimes result from group responding. Learning correct pronunciation is greatly assisted by the clarity of headphone reception.

The amount of speaking practice is greatly increased. Each student is provided with the opportunity to get much more speaking practice than is usually provided in a group instruction situation. Instead of waiting turns and speaking only a few lines during a class period, each student can practice steadily for as much of the period as it is deemed desirable.

Recording and comparing responses assists students in eliminating errors and fixing language patterns. By recording their responses to the master material and then playing back these responses, students are given opportunity to compare their work with that of the master. When mistakes occur, the students repeat the record-listen-compare cycle as many times as necessary to eliminate them from their responses.

Students gain a high degree of self-confidence through laboratory practice. The semiprivate effect of the headphones and the partial enclosure of the booth markedly lessen the self-consciousness that most adolescents and many adults experience when they are required to respond orally in a group, especially during the early phases of language study.

Students may proceed satisfactorily at their own learning rates. When language laboratory facilities are used, the class practices simultaneously; and yet each student may go on to more advanced material whenever he is ready for it, or he can continue to repeat the practice until the material that has been assigned is adequately mastered. At the college level where students study independently on campus, the laboratory provides opportunities for individual language practice outside of class periods.

The teacher is free to work directly with each student via the intercommunication circuit. This direct but private contact enables the teacher to evaluate the progress and learning difficulties of each student and to provide the needed assistance and guidance. The laboratory facilities also make it possible for the teacher to work directly with a small group of students simultaneously through the intercommunication circuit or by means of placing groups at desks, tables, or tablet-arm chairs in the front of the room.

Types of Language Laboratories

Language laboratory facilities to date have varied considerably in design, construction, and cost (1) from simple and inexpensive equipment that is added to existing classrooms to complex and costly installations that are made in specially designed rooms; and (2) from facilities that provide only limited language practice activities to ones that attempt to meet all possible needs.

Some extreme variations in the early development of language laboratory facilities were probably due to the fact that school districts lacked experience in planning these new language tools and even in using them. Also, manufacturers and suppliers have been uncertain regarding the design and the quality required of the facilities. During the past year, however, equipment of a more uniform type has been produced and is being installed in many widely separate school districts.

Even with this trend toward uniformity in language laboratory design, it is not probable that a standardized design will meet the requirements of all schools. Language teaching practices, like those in other subjects, can be expected to vary somewhat among teachers and among different age groups of students. These differences, plus those of school budgets, will probably continue the need for each school or school district to decide for itself the specific pattern of language laboratory facilities that will best meet its own requirements.

After planning the kind of language laboratory facilities deemed the most appropriate, a school district prepares a set of educational specifications that state the instructional functions that the laboratory is expected to perform. These specifications "are essential for use by the business office in obtaining the quotations or bids from equipment suppliers and to ensure that the facilities purchased and installed will provide for the planned functions to the degree specified."[1] The specifications should set forth the size and type of laboratory desired. The *size* is determined by the number of student stations and the number of sound channels that are to be used simultaneously. The *type* of facility is expressed in terms of (1) the kinds of language practice activities desired; and (2) the utilization plan that has been developed for the facilities.

The laboratory facilities selected by a school district would consist of one of the types described in the sections that follow.

Types—in Terms of Kinds of Audio-Lingual Practice Activities

The types of language laboratory facilities that should be considered in terms of audio-lingual practice activities are ranked according to "class" or "level."

Class I—listening only, to prerecorded materials. Sometimes termed "Level I," this type of facility can be as simple as the assignment of a tape recorder to a foreign language classroom for regular use of prerecorded materials. However, the addition of wiring for sound transmission and headphones for student listening provides a greatly improved listening facility.

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[1] *A Guide for the Development of Language Laboratory Facilities.* Prepared by the Bureau of Audio-Visual and School Library Education in cooperation with the Bureau of National Defense Education Act Administration. Bulletin of the California State Department of Education, Vol. XXIX, No. 10, October, 1960, p. 19.

Class II—listening and responding, to prerecorded materials. This type of facility, sometimes referred to as "Level II," provides for efficient listening to prerecorded practice materials via headphones plus oral response by the student via a microphone. The design of this kind of facility permits the student to hear clearly his own responses. It also permits the teacher to listen to and to talk with each student privately. Usually acoustic separators are placed between student stations; these partitions form "booths" that reduce sound interference.

Class III—listening, responding, and recording. Often designated as a "Level III" installation and sometimes inaccurately spoken of as a "complete" laboratory, this class of facility provides the most satisfactory method at the present time for enabling each student to have repetitive oral practice at his own rate of progress. By use of a student station recorder, each student is daily provided with his own "master lesson" and with the means to record and play back his own responses for repeated comparisons with the master example until he has attained a satisfactory degree of accomplishment. Since this type of facility requires a specially designed dual-channel tape recorder at each student station in addition to the equipment in a Class II installation, it has a much higher initial cost than that of the Class I or Class II type and usually requires greater maintenance expenditures.

TYPES—IN TERMS OF THE UTILIZATION PLAN

Types of language laboratory facilities may also be considered in terms of the instructional plan regarding how the facilities are to be utilized.

The independent practice type. Sometimes called the "library" type, this laboratory facility is planned for the use of students outside of regular class instruction periods. It may be located in a glassed-in area adjacent to a classroom; with this arrangement, general control may be exerted by a nearby classroom teacher. More often, however, it is a part of the school library facilities. Since the student practices completely by himself or with the occasional help of a teacher or laboratory assistant, Class III equipment is required, but generally only a few stations are installed.

The classroom practice type. This type of facility—the one most widely used—requires a student station for each member of the class group. It permits independent audio-lingual practice activities on the part of each student but requires that this be done during scheduled class periods. Most important, the teacher is available constantly to supervise the students' practice, that is, to assist each student as he needs help and to check his progress so that he is not repeating exercises needlessly or "fixing" errors.

CURRENT PATTERNS OF LANGUAGE LABORATORY INSTALLATIONS

A few schools have constructed their own language laboratories or have assembled and installed them out of purchased components. However, most public schools and most colleges and universities have contracted with established suppliers for language laboratory installations. The sections that follow contain descriptions of common patterns of design and installation.

AT THE COLLEGE LEVEL

Foreign language departments in colleges and universities have given leadership in exploring and developing language laboratories. Some of the early installations consisted of relatively simple listening facilities only. However, in the past few years the majority of college language laboratories have been of the Class III type. And they are usually arranged for independent practice by students outside of class periods, often under the supervision of a language laboratory technician. There is a trend, nevertheless, for the number and arrangement of the student stations to be increased so that whole class groups can be scheduled at one time with the instructor in attendance.

AT THE SECONDARY SCHOOL LEVEL

Early high school language laboratories tended to be replicas of collegiate installations. Increasingly, however, secondary schools have required and developed a design more appropriate for the instructional organization of high school programs. The majority of high school installations now are of the type that involves class group practice. There is a tendency to favor the Class II type of facility, probably because of budget reasons, but also because it is relatively simple for students to use. Many schools provide for a few of the student stations to have Class III equipment; under this provision, student use of these stations is rotated to secure some of the advantages of the "record-and-compare" type of practice activity.

At first, high schools tended to provide only one language laboratory per school, even in large schools. Hence, use of the laboratory was rigidly scheduled. Sometimes the installation was in a room not otherwise used, but frequently it was in one of the regu-

lar language classrooms; this necessitated a "musical chairs" routine for use of the facilities by all of the classes. There is evidence now that an increasing number of junior and senior high schools are recognizing the importance of daily short periods of audio-lingual practice—especially during the first two years of language study—and are therefore equipping each foreign language classroom with its own laboratory facilities. Many schools are providing student stations without the acoustic separators or stations with fold-down partitions to make the room easily convertible for purposes of (1) language laboratory practice; or (2) regular class activities.

AT THE ELEMENTARY SCHOOL LEVEL

Only a comparatively few elementary schools have installed language laboratory facilities of the types used by secondary schools and colleges. Many elementary schools have installed Class I listening units in their classrooms—usually in the form of a "listening corner" to enable small groups to have the experience of listening to records or tapes. However, elementary school foreign language instruction seems to be making considerable progress in the use of correlated visual and sound materials. Instruction via television is also being used extensively, but more as a substitute for trained language teachers than as an audio-visual language learning device. As foreign language instruction in the elementary grades becomes more widely established and as it becomes more clearly delineated as to organization and techniques, audio-visual and electronic devices will likely be developed to an extent that they will be substantial and effective aids in the foreign language instructional program.

SOME GUIDELINES FOR PLANNING LANGUAGE LABORATORY FACILITIES

Educators are recognizing the fact that language laboratory equipment and materials that are of the highest possible quality are most effective aids to students in the job of learning accurately the unfamiliar sounds of a foreign tongue. Consequently there is an increasing demand on the part of the schools that the design and construction of language laboratory facilities provide for quality of sound equivalent to that of the natural voice. The requirements for high quality of sound reproduction apply not only to the "live" processes that take place in a language laboratory, such as intercommunication, recording, and responding, but to prerecorded tapes and discs as well.

Laboratory layouts should provide for increasing use of projected visual material that is correlated with aural-oral practice exercises. Accurate association of the spoken-language sounds with the objects, situations, and concepts for which they have meaning is an essential element in the audio-lingual approach to language instruction, particularly in the beginning phase. Heretofore, the emphasis has been on acquiring sound-reproduction facilities for practice purposes; however, related visual materials—slides, filmstrips, and motion pictures—are now being prepared for classroom utilization, and language laboratories should be so designed that these materials can be used to advantage.

Classroom-laboratory combinations should not freeze the foreign language classroom into a rigid arrangement; neither should the laboratory equipment take up all the space in the room. Although the instructor's console and the student stations are connected by wiring and must be in fixed positions, as much space as possible should be left for other kinds of language learning materials and activities—for example, simple dramatizations, bulletin board displays, realia exhibits, posters and photographs for background atmosphere, shelves for reference books and periodicals, and chalkboards.

It is important that school districts carefully check their bid notices to ensure that only essential features are specified. Sometimes the use of a manufacturer's specifications will include in the bid requirements some "gimmick" that is peculiar to a certain laboratory design but unessential to the efficient functioning of a laboratory in a given school. It is also recommended that more than one bid be reviewed; the elimination of competitive bids generally increases the cost of the facilities needed.

It is becoming increasingly possible for schools to make a simple and relatively inexpensive start in acquiring basic laboratory equipment (for example, a tape recorder for each language classroom) and then, over a period of time, to add some additional features (such as headphones, microphones, console, and even student recorders) without loss of the initial investment.

When a school district selects language laboratory equipment, emphasis should also be placed upon simplicity of operation and ruggedness of construction. Operational directions should be required of the supplier who furnishes the equipment or who makes the installation. Some maintenance of the facilities is to be expected—both preventative inspections and replacements—since operation of the equipment obviously brings on wear and deterioration. The design of the facilities should provide for ease of maintenance, which should be based upon the instructions and diagrams furnished by the supplier or installer.

School administrators and school patrons need to be aware that the acceptance of the new goals for spoken language competency and the audio-lingual approach in teaching spoken language represent a major adjustment for foreign language teachers, most of whom have had training and experience toward different objectives and with different techniques. Learning to use the new tools for the new approach—the language laboratory facilities—is an added complication. Then too, many adjustments in the language curriculum will be required as colleges, high schools, and elementary schools seek to provide and maintain a coordinated continuity of language learning. Caution, patience, and mutual forebearance as well as enthusiastic efforts to apply the new possibilities with maximum benefit, are needed by all who are concerned with these important developments in foreign language instruction.

CHAPTER VI

INSTRUCTIONAL TELEVISION

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Director of Research
Department of Cinema
University of Southern California

·How often is
census taken?
·When and how
it get started?
·Why and how is
taken?

The National Defense Education Act has had a substantial effect upon the development of instructional television in California schools, directly as a source of funds for equipment and indirectly as a means of focusing attention on the role of television in the instructional program. It is appropriate, then, that an assessment be made of the value of instructional television, the educational uses to which it may be put, the problems and questions that are being raised about its use, and its place in the total instructional system.

Values of Instructional Television

Television can make a worthwhile contribution to classroom instruction. It can improve instruction, stimulate learning, supply valuable content, and serve as a means of meeting some pressing administrative problems.

Many research studies show that television can be used for instruction and learning at all levels, that such learning is as measurable as conventional learning, and that the key to the value of television as an aid to teaching is the way in which it is used.

Types of Instructional Television

The TV lesson or presentation reaches the student in the classroom in one of three different ways—through broadcasts over a TV station, through closed-circuit cables, or as a magnification of something in the classroom itself.

Broadcast TV: Commercial and Educational Stations

Most people associate television with broadcast programs, transmitted at specific times over licensed channels, viewable by anyone with a TV set within the reception range of the broadcasting stations. These may be commercial stations broadcasting occasional educational programs or noncommercial educational stations devoting their total time to cultural and instructional programs. Approximately 75 noncommercial educational stations are operating in the United States, two of which are in California (KQED in San Francisco and KVIE in Sacramento). Channels for six additional noncommercial educational stations are allocated to California. It should be noted, however, that if all eight of the channels allocated to California were in use, the facilities would still be inadequate for the schools to have the programs they require at the times when the programs can be used to best advantage.

Broadcasting facilities can be a means for successfully presenting certain instructional programs to schools and to home audiences. However, the diversity in the instructional programs offered by the schools in an area served by a television broadcasting station makes it impossible for the station to offer a program that meets all the requirements of the schools. Instructional television (ITV) may therefore have to be used in major part to present programs in subject areas such as arithmetic and spelling, subjects in which a fairly well-established sequence of presentation is employed, and for presenting current events and special programs that may be utilized to advantage in various courses taught in the schools. Programs that deviate from patterns of wide usage might better be presented locally over closed-circuit TV facilities in the schools.

Closed-circuit Television

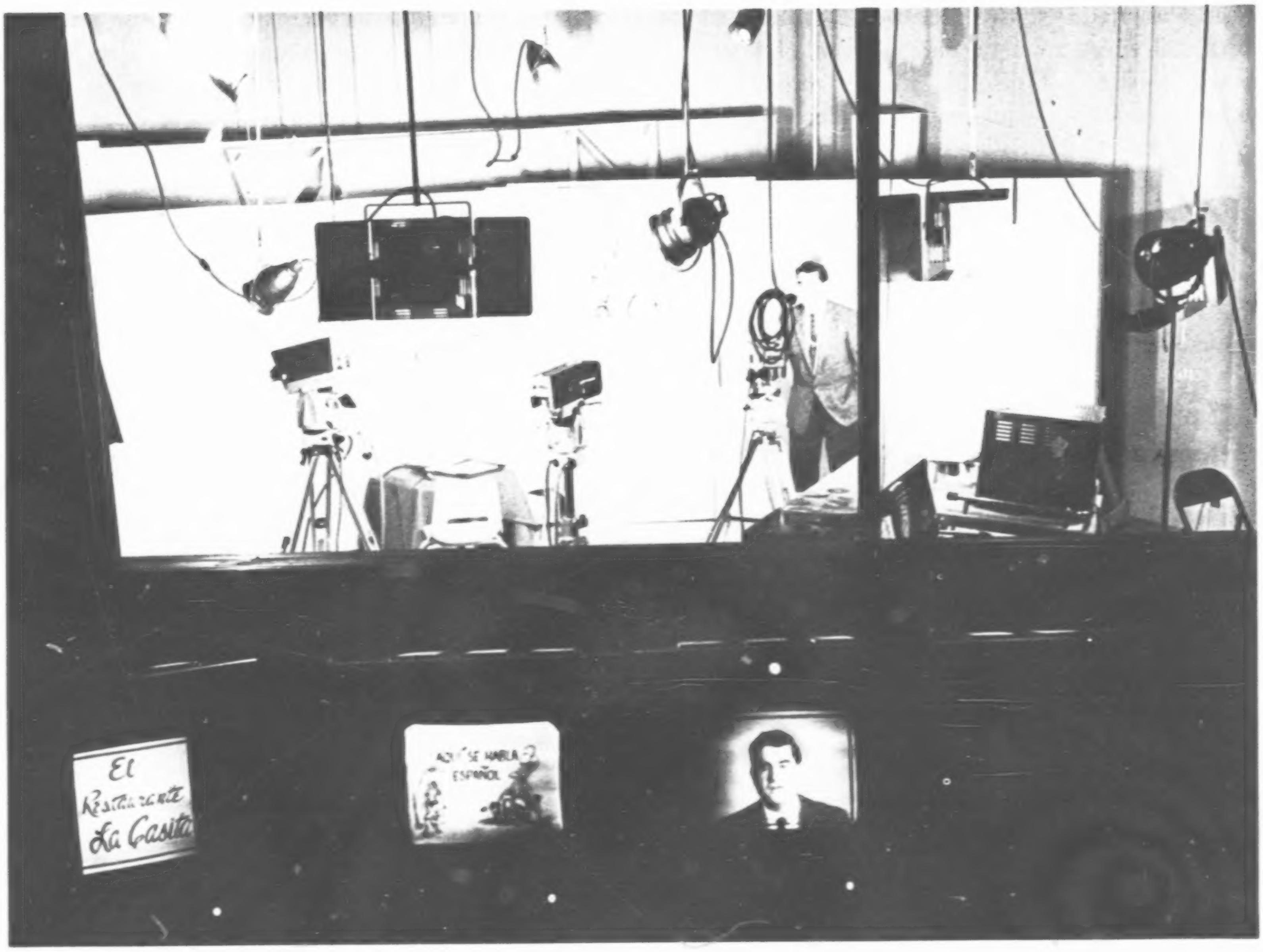
Every school district could install closed-circuit TV facilities. The facilities installed may be adequate only to serve a single school or the schools in a district; or they may be as elaborate as the one at Hagerstown, Maryland, where all the schools in the county, an area of more than 400 square miles, are linked together by coaxial cable.

The Anaheim Elementary School District, Orange County, has the largest closed-circuit system in California. Closed-circuit systems have also been installed in a number of the junior colleges, colleges, and universities in California.

Although closed-circuit television permits local programming to meet each school's specific education needs, it necessitates additional space, facilities, and staff. A school district, however, may start such a system in a single classroom, extend the system gradually to include all the classrooms in the building, and then extend it to include all the schools in the district.

Classroom Magnification Television

The most inexpensive and one of the most effective uses of closed-circuit TV it is employment in the classroom as a magnifying device or as an overhead



display board. It is particularly effective in the presentation of science materials and demonstrations, because it can enlarge tiny objects so that they may be seen on the TV monitor by the entire class. Bretz, head of ETV at the University of California, Los Angeles, constructed an overhead TV system at a cost of about $1,200.

There is no "best" way to bring ITV into the classroom. The method or combination of methods used will depend upon the availability of TV broadcasting in the reception area, the financial condition of the school district, and the philosophy of education the schools employ. Many school districts make exclusive use of broadcast ITV or of closed-circuit TV. However, both may be used in combination at slightly increased costs and should be used as needed to secure the most effective instruction.

Uses of Instructional Television

Instructional television may be used (1) as a source of enrichment; (2) as a means of presenting courses; (3) as a medium for communication; (4) as a teaching device for large groups, for individuals, and for home-viewing assignments; (5) as a means of magnifying small objects; and (6) as a means of presenting materials that generally are not available to the classroom. The value of instructional television is determined by the uses that are made of it and the results that are obtained.

Television for Enrichment and Supplementation

Most of the broadcast televised instruction used in California schools is designed to enrich and supplement classroom instruction. In other words, it is something extra, something good to know, but not necessarily basic. Whether the teacher uses the full programs or only selected parts of them, classroom instruction is generally enhanced, and students get certain information and insights they might not get otherwise. The televised programs can be employed in about the same manner as instructional films, and when used properly they generally make important contributions to the classroom instructional program.

TELEVISION AS A MAJOR TEACHING RESOURCE

The televised lessons for a complete course may be employed in the classroom as the basic instruction for the course. When this is done, the direction of the course is determined by the teacher in the TV studio, and the structure of the course is imposed by the TV lessons. The classroom teacher follows this structure, fits his instruction to the organization of the TV lessons, and facilitates student learning through discussion, experimentation, group activities, and the like. Closed-circuit TV lessons are particularly valuable in subject areas where there is an adequate supply of qualified teachers. It is true, however, that this type of instruction places the classroom teacher in a somewhat different role than the one to which he is accustomed, because he loses some freedom of choice in what to teach. This changed role does not necessarily lessen the importance of the teacher's role in the instructional program, for all instruction must be adapted to the individuals doing the learning.

There is no evidence that students consider the TV (or studio) teacher as having a position superior to that of the classroom teacher. They respond to the television teacher when responses are elicited but turn to the classroom teacher for help and for guidance in solving their problems. There is no reason to think that the classroom teacher's status in his class is in any way jeopardized or demeaned by sharing the instructional tasks with a TV teacher.

Televised instruction may be used by the classroom teacher to enhance his teaching effectiveness. Televised instruction makes available to the classroom teacher the assistance of specialists who are highly skilled in presenting information and ideas. And as a result of having this assistance, the classroom teacher has opportunity to devote considerable time to each student.

The use of television in the classroom makes it necessary for the teacher to learn certain new techniques of instruction. He must learn to feature his role as guide, interpreter, and evaluator of learning experiences rather than as a transmitter of informa-

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tion. He must plan his work so that the instruction given by television, film, or any other mechanical medium is productive.

Television as the Sole Source of Instruction

Sometimes all the instruction for a course is presented in televised lessons. However, in most instances the televised instruction is supplemented by textbook assignments and the use of syllabi. Thus far televised instruction has been given mainly at the college level and in adult education programs, but there is evidence that in the near future it may come into wider use in some phases of secondary education.

Problems Raised by Instructional Television

The three basic problems involved in securing increasingly wide and effective use of instructional television are (1) how to achieve teacher competency in its uses; (2) how to obtain administrative support for it; and (3) how to improve the quality of the programs.

Achieving Teacher Competency

Experience throughout the nation has shown that the success of instructional television depends largely upon the ways televised programs are used in the classroom. The values derived from their use in the classroom depend in large part upon the classroom teacher's ability to use the programs wisely. The ways in which this can be accomplished follow:

Prepare himself for the lesson by reviewing its purposes, mastering the study guide, and accepting the TV teacher as part of a teaching team whose purpose it is to secure maximum learning.

Prepare members of the class for learning by informing them of the purpose of the lesson. Carry out the preparatory steps recommended in the study guide wherever possible and demonstrate through actions and attitudes that the televised lessons are important.

Provide purposeful exercises for the class to perform during the telecast. These may consist of overt responses to the televised teacher, completion of written exercises at appropriate points during the telecast, and other activities that involve the class in learning from the TV lesson.

Follow up the telecast lesson by discussion and assignments—written reports, experiments, drill exercises, and the like.

Obtaining Administrative Support

No matter how interested the classroom teacher may be in using the resources of ITV, unless the school administrator actively supports and encourages experimentation with televised instruction, little progress can be made in using such instruction in the classroom. When the administrative staff of a school district sees to it that ITV is given a fair trial in the classroom and that its use as a teaching tool is evaluated objectively, favorable teacher reaction to the role of television instruction generally follows.

The administrators of most schools received their training and experience during the years when very few technical innovations were employed in the instructional program. Within the past few years this situation has changed, and demands are now being made to use technological devices for the improvement of instruction. Instructional TV is one of the devices that may be used for this purpose. School administrators should therefore understand ITV, know its potential uses, and be prepared to utilize it in the instructional program. Administrators may acquire the information by taking the following steps:

Study the ways television instruction is being employed in the different parts of the country.

Determine the possible uses of television instruction in the schools of the district.

Become involved with regional ITV planning.

Give ITV a tryout under favorable conditions and encourage teachers to use television instruction in their classrooms.

Study the place of TV in teaching in relation to other media, methods, and the new administrative innovations such as those proposed by Trump and Baynham in *Focus in Change: Guide to Better Schools.*[1]

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[1] Lloyd J. Trump and Dorsey Baynham, *Focus on Change: Guide to Better Schools.* National Association of Secondary-School Principals. Chicago: Rand McNally & Co., 1961.

IMPROVING PROGRAM QUALITY

When teachers use ITV lessons effectively and school administrators support the development of ITV, one overriding problem still remains—the quality of the ITV lessons. There are decided differences of opinion regarding the quality of ITV programs, and those who are responsible for the production of the programs are especially sensitive to the criticisms expressed. Televised programs of instruction appear to be caught between two strong forces: the pressure of educators for solid educational content and the pressure of TV broadcasters for the added element—showmanship. The result often is a compromise that produces neither good education nor good television. Too many programs are dull, uninspired, and unimaginative and in other ways fail to possess the characteristics required to improve instruction. On the other hand, production gimmicks and visual tricks sometimes liven up programs that have no real instructional value.

It should be noted that any broadcast television reaches a large audience, and deficiencies are readily observed and widely criticized. On the other hand, deficiencies in conventional classroom instruction may continue year after year, unobserved and uncorrected. Therefore, it is the responsibility of ITV program planners and producers to develop a quality product—one that is consistently good. The quality of educational telecasts depend upon the following practices:

Constructive evaluation of ITV programs by classroom teachers and accurate reporting of the results of the evaluation to those responsible for the instructional programs

Insistence by school administrators upon quality telecasts rather than upon the quantity required to fill up program time (The administrator must stand his ground against the TV producer who will often use his technical know-how to intimidate the educator.)

Provision of information regarding educational problems and objectives to commercial television stations

The willingness of educational television station managers to spend as much effort on programs designed for school use as is required to make the program equal in quality to the other programs offered by their respective stations

There are other problems that ITV poses—raising funds, overcoming the limitations of schedules, and meeting the differing educational needs of numerous school districts—but the three problems discussed here appear to be the crucial ones. Without classroom teacher competency in the uses of television as a teaching tool, without adequate administrative support and encouragement, and without a high level of ITV program quality, the potential instructional value of television may never be realized.

Place of Television in an Instructional System

Television must be viewed in proper perspective along with other instructional media and methods of teaching. Television is but one of a group of resources that teachers can use as teaching tools. Television can, however, play a unique role in the instruction program.

The following four approaches are commonly used in the presentation of instruction:

The printed materials approach. Use of printed materials, such as textbooks and library books, for instructional purposes is deeply rooted in tradition. However, this approach may be enriched by using it in various combinations with other approaches.

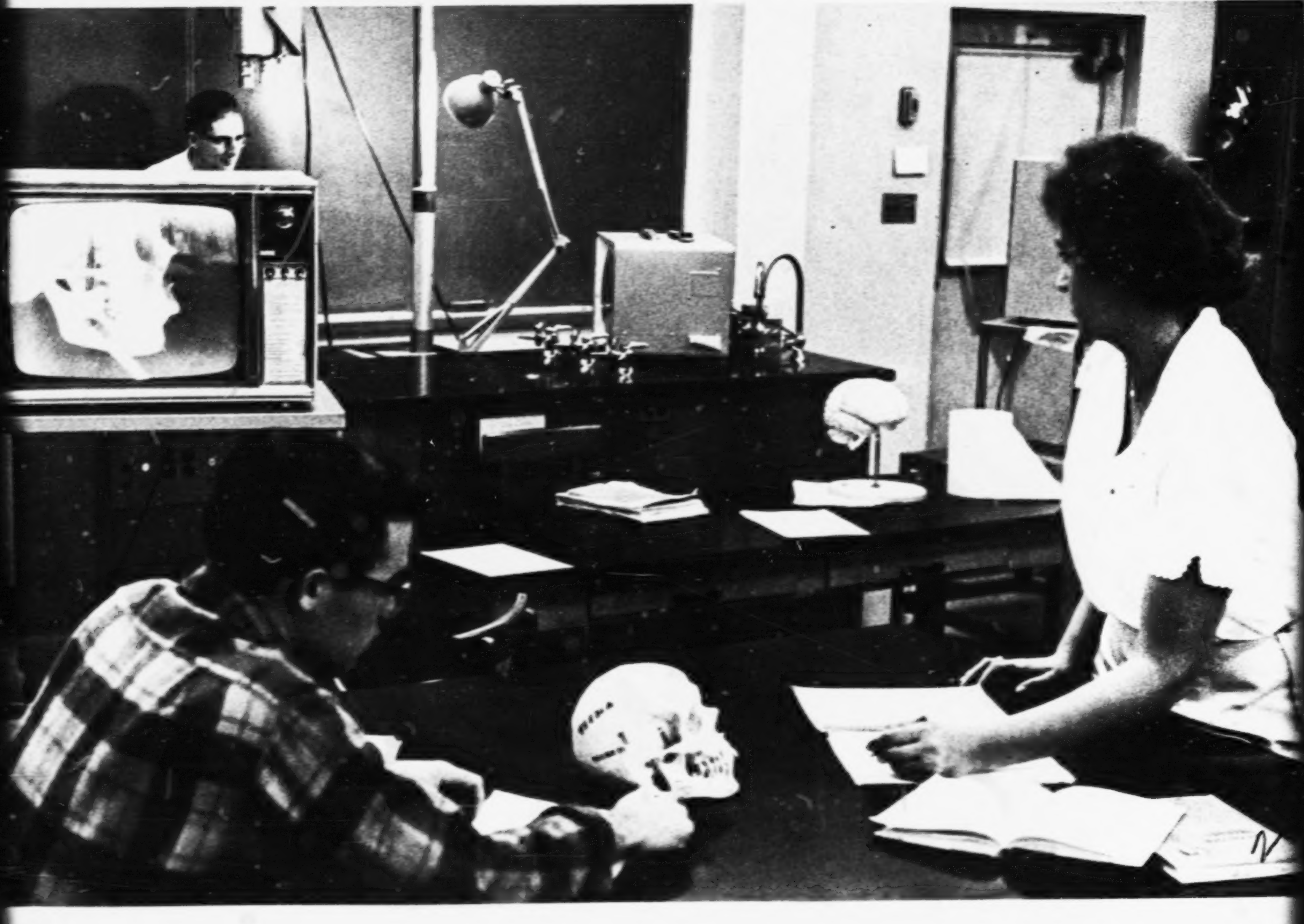
The audio-visual approach. The audio-visual approach is characterized by featuring the use of films, filmstrips, recordings, and other audio-visual materials in conjuction with other curriculum materials.

The television approach. Recently television has advanced as a medium for assisting the teacher. This advance will continue provided that the materials used are prepared under the direction of personnel with good educational backgrounds by personnel who are well qualified to produce television programs.

The teaching machine approach. Within the past two years the teaching machine approach has opened interesting possibilities for instruction. However, the extent to which this approach will be used in the future depends upon its acceptance by the various groups responsible for the educational program.

Each of these four different and important instructional approaches has its own proponents and specialized advocates who have unique and significant contributions to make to education but who make little conscious effort to coordinate their activities toward a common educational goal. With a few notable exceptions, each specialist is competing with the others for recognition of his particular medium as the favored teaching tool, and each tends to look with skepticism on claims for the other media. This is probably unavoidable because it is desirable, to some extent, to have dedicated specialists who promote their own beliefs. But this situation leads to emphasis upon a specific medium rather than upon the crucial issue—how to solve instructional problems by the best means and combination of means. Not until a coordinated effort is made to use these four approaches in effective combinations will the full value of all available instructional tools be realized.

Instructional television has its place in the instructional program, but it is just one of several means available that may be employed to improve the educational product. One of the important tasks of educators within the next few years is to find how this can be done and then to take the necessary steps.



CHAPTER VII

TEACHING MACHINES AND PROGRAMMING

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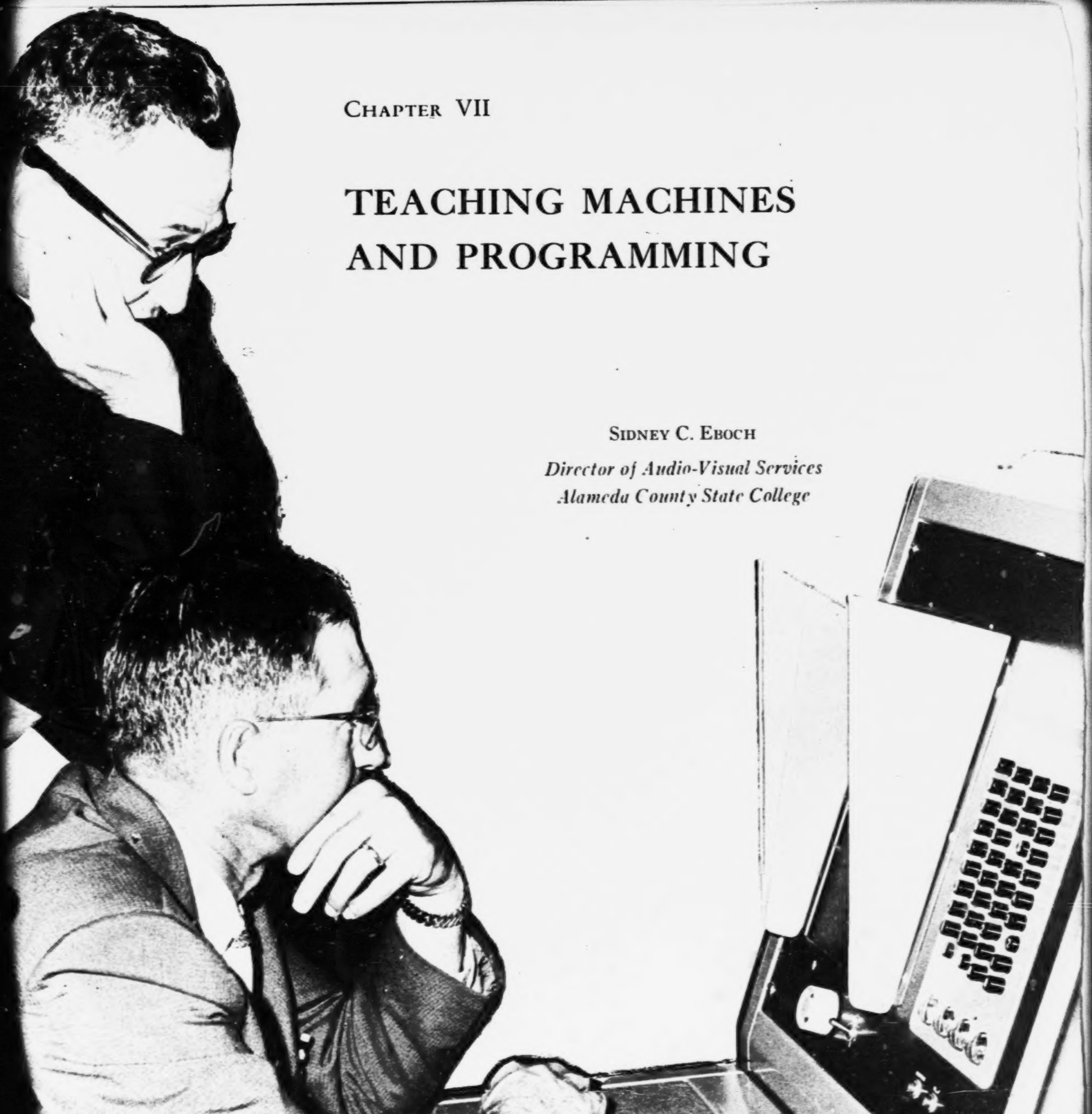


Teaching machines have been pictured as potentially revolutionary educational devices that can make dramatic contributions to the improvement of instruction. Americans in general and educators in particular have had mixed reactions to the advent of the teaching machine and the programmed materials used in conjunction with it. On the one hand, they fear the threat that the machine and its materials pose to individual expression. On the other hand, they welcome these innovations as means of helping them to do more effective teaching.

THE MACHINES

Although mechanical devices of various kinds have been in educational use for decades, teaching machines constitute the most recent development. A number of different types of machines have been and are being manufactured. There are comparatively simple types that are operated manually, more complex ones that are automated, and some highly complex ones that are electronic. As they are considered in this publication, teaching machines have the following basic characteristics and functions:

1. They present information in relatively small units or "steps."
2. They require a decision or action on the part of the student at each item of information or step.
3. They inform the student of his degree of achievement immediately after each of his decisions or actions—i.e., whether he has succeeded or whether he needs correction or improvement.

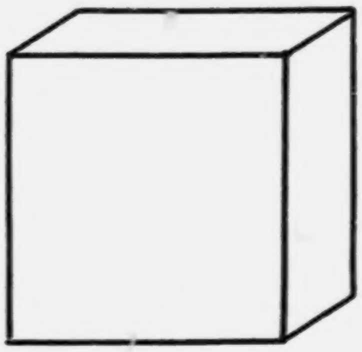
It is the combination of these characteristics and functions, the prearranged sequences of the materials used in the machine, and the continuous control that the machine exerts upon the learner during manipulation that has given so much power and effectiveness to teaching machines as educational aids.

THE MATERIALS—PROGRAMMED STEPS

Although teaching machines require the use of some physical material, the form of the material has shown variation. In most machines, paper products—cards, sheets, or rolls—have been used. More complex devices have used film materials in the form of slides or reels. Some machines have combined visual materials with recorded sound.

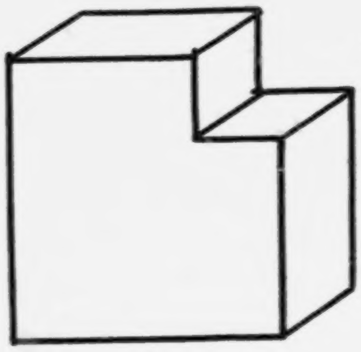
Regardless of the form of the physical materials used, the information presented by means of the teaching machine is arranged in a series of carefully organized or programmed *steps*. Each step involves the following phases:

1. *Presentation of a small unit of information.* A small unit of information is presented for student absorption. The unit may be one or more sentences or a paragraph in length—rarely exceeding three paragraphs. A simple diagram or photograph may be included. Brief motion picture sequences are occasionally used in conjunction with the unit material.



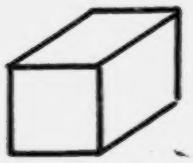
Information symbol

2. *A stimulus statement.* A stimulus statement is an incomplete "fill-in-the-blank" sentence or statement that calls for a specific response. It is the student's responsibility to consider possible alternatives and to complete the sentence by supplying the missing element.



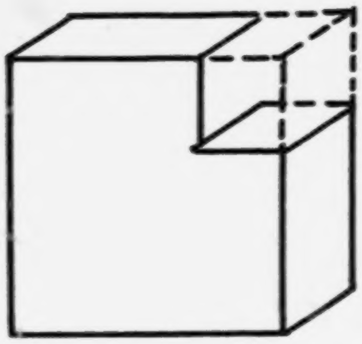
Stimulus symbol

3. *The student response.* The student response is or becomes an integral part of the material. It may be the actual writing of the missing part, the selection of the next appropriate page in a book, or the punching of a button on a machine. With some machines, a response is required for each unit before the student can advance to other units.



Response symbol

4. *The reinforcement/correction element.* The reinforcement/correction element consists of additional information provided to the student regarding the degree of achievement he has made in his response. For example, if the student is correct in his response, his answer is reinforced; he is told he is right. If he is wrong, he may be told the correct answer, given remedial instruction, or presented with other material to study or work out. The initial information may be as simple as the appropriate word that is required for a response, or it may be as complex as a large number of additional steps to increase the student's capacity to respond properly. In any event, the student is continually (a) informed of his level of success; and (b) assisted toward the intended goal.



Completion symbol

Program Technique

Units of information—or programmed steps—that are presented through the medium of a teaching machine may be organized in a variety of sequential patterns. However, two particular patterns of sequence are used with the greatest frequency; *linear* and *branching.*

The Linear Pattern

The linear pattern features a fixed, uniform sequence of steps. The student works through the programmed material, making each response in a step-by-step order. This order is the same for all students.

The Branching Pattern

The branching pattern also has a sequence of steps, but these contain only the main essentials necessary for understanding the content of the program. In addition, this type of pattern contains several "branches" or subsequences of steps. These branch off from the main line in order to present more information, to clarify essential concepts, or to give remedial instruction when errors are made. Thus, students proceeding through a branching program may use varying sequences of steps, depending on each student's understanding of any given point. More alert students might use only 30 percent of all steps offered by selecting the more appropriate responses and "staying on the main line." Less able or less informed students might use as much as 80 percent of all steps offered; they take additional steps or branches because their responses indicate a need for additional information in the subsequences or branches of the program.

Textbook Programs and Machine Values

Textbooks prepared along the lines of both the linear pattern and the branching pattern were developed simultaneously with teaching machine equipment. In many instances it was found that programmed materials could be presented in book form as readily as in a form appropriate for teaching machines. Serious questions, therefore, have been raised as to the values and economies of machines-with-programs when compared with programmed textbooks. There is strong evidence, however, that teaching machines using programmed materials have some inherent characteristics not possessed by programmed textbooks alone.

ADVANTAGES OF MACHINES

Certain advantages in the use of teaching machines are cited in the paragraphs that follow.

Student control. Machines can control uniformly and consistently the sequence of presentation. A student using a programmed textbook might change the sequence at his own discretion. With a machine, access to the correct answer (reinforcement/correction element) is available only at the appropriate time; backtracking to alter an answer is not possible. In textbook form, answers can be located and used by the student if he so wishes.

Lessening of teacher's burden and saving of time. Machines can time, record, and score all student responses automatically; the analysis of student performance can be computed and reported immediately with little teacher effort. Responses for programmed textbooks may number in the thousands. An analysis of such numerous responses would impose an unreasonable burden on the teacher, and student performance reports would likely be greatly delayed.

Minimum space required. Machines and their programs require a minimum amount of physical space. A course program in textbook form, however, would require many times as much space. Moreover, bulk materials involving the machines can be handled easily and stored conveniently in the form of film or magnetic tape, as has already been demonstrated by organizations and firms that must deal with the storage, retrieval, and dissemination of enormous amounts of information.

Individual progress. Because individual progress is one of the major keystones of any educational program, educators have become increasingly concerned with ways of enabling students to make good progress individually in the face of mounting enrollments and teacher shortages. By their very nature, teaching machines and the programmed materials for which they are the vehicles control, guide, and assist the individual; the emphasis is on the progress of the individual rather than on that of the group. These aids have already proven to be highly effective means by which the learner can make substantial progress according to his own abilities and regardless of class size.

Potential uses. It must be remembered that teaching machines currently available are in their early stages of development. Research and experimentation are going on constantly, and improvements of considerable magnitude are anticipated for the use of school districts. Industry has already developed, for example, a system whereby hundreds of teaching machines located in different classrooms and buildings can be linked to a computer installed at a central location in the school plant. By programming the computers properly, it is possible for large numbers of students to work simultaneously on individual programs in different subject fields, each with opportunity to learn at his maximum rate and to the full extent of his ability.

If the basic values of programming technique are demonstrated as equal to current expectations, technological improvements and innovations might be not only desirable but essential to the effective use of programmed materials.

PROBLEMS INVOLVED

Although the advantages in the use of teaching machines and programmed materials appear to be numerous and far-reaching, educators should not overlook the fact that certain problems will arise or may arise in relation to these instructional aids. Among these problems, the following two are briefly discussed.

Maintenance and repair. Some teaching machines are relatively simple devices and need only a minimum of upkeep; the maintenance required can often be handled by district personnel. Other machines, however, particularly those of complex construction, require that qualified machine technicians, replacement parts, and appropriate servicing tools be available so that the machines can be kept in good operating condition and can be properly repaired as the need arises.

Purchase costs. Some teaching devices are comparatively inexpensive; others are more costly; still others may be beyond the purchasing ability of certain school districts. It would seem that in this matter of costs, the major considerations would be that each school district contemplating the use of teaching machines should do the following in this order: (1) evaluate its instructional program in terms of needs; (2) determine what types of machines and materials could best be used to help meet these needs; (3) estimate the extent to which the district budget would allow for the purchase of machines and materials; and (4) select, according to budgetary limits, only those machines and materials that the district considers would be most advantageous to the educational program.

The Immediate Future

What can we expect to find in the field of teaching machines and programmed materials in the very near future? Educators can expect to face several problems.

The basic and immediate problem for education will probably have to do with increasing the quality of machines and programs. Because of the nationwide pressures to meet certain educational needs and because of the great amount of publicity that has been given to teaching machines, it is not unreasonable to anticipate (1) that the teaching machine industry will be flooded with numerous low-cost, hastily conceived products of dubious value; (2) that before inferior devices are "washed out" of the market, many will be sold to the unwary buyer; and (3) that programs prepared without sufficient thought or planning, untried by any means, and cleverly packaged will glut the market. In the face of such possibilities, however, educators cannot ignore the potential value of these devices for teaching and learning. Education would serve its own cause best by becoming involved in the field as quickly, as deeply, and as critically as possible.

How Can the New Aids Be Approached?

In what ways can education approach these innovations—which promise so much—in order that really good use can be made of them? In general, three courses of action are open. All could be started simultaneously.

Becoming Well Informed

Literature concerning teaching machines and programmed materials is being published by such institutions as the National Education Association and the Center for Programmed Instruction and in journals related to such fields as audio-visual education and psychology. Not all teachers and administrators will have access to this literature. Audio-visual directors and coordinators and other personnel involved in and specializing in aids to instruction should facilitate the flow of information regarding these new tools by noting, abstracting, or summarizing important developments in behalf of teachers and administrators by means of local publication or through conferences and workshops. These leaders, moreover, can contribute to the flow of information by reporting activities within their own groups and by raising the questions and problems that have to do with practical application.

Conducting Experiments

Very simple "action research" can be carried out by school districts. This activity need not be complex or costly; it merely requires an honest trial of machines and materials. Thorough experimentation with several devices and programs, for example, would cost less than two television sets. Whatever is done should be based on the premise that all machines and materials are expendable. If the machines or the materials prove valueless, other districts should be informed of this fact.

Providing In-service Training

In-service training of teaching personnel could be started. This means a well-organized, continuing course of training, from an introduction of basic concepts to a form of controlled testing of machines and materials in the classroom. (Several types of activities that might be pursued in such a training program are listed in the sections that follow.) Not all teachers would be involved in all activities related to the new aids, but the entire staff should be informed regarding the efforts that are being made with teaching machines and programmed materials and the results that are being realized. There should be systematic provision for all teachers to participate in any or all phases of the training program that are of interest to them.

A training program of this type might be conducted by the audio-visual director, a specialist from his staff, or by one or more teachers with special training or skills in programming techniques.

Nearby colleges, universities, or industrial firms may have personnel with special skills who could help conduct the training program. The major point is that long-range planning is needed, not just for the use of machines and materials, but in the preparation of the entire school for all the changes that might arise from the introduction and operation of such a system of instructional tools.

WHAT CAN ADMINISTRATORS DO?

What can administrators of schools and school districts do to determine ways in which the new aids can benefit the instructional program under their jurisdiction and to make it possible for these benefits to be realized? The following steps are suggested:

1. Get the audio-visual director to work immediately on the problem of how the school or school district can best be served by teaching machines and programmed materials. Specialists in audio-visual education have been the persons most directly concerned with these new devices and materials and with their application to the instructional program.
2. Invest in several machines and materials for experimental purposes. Set up cooperative arrangements with nearby districts or adjacent counties involving the classroom trial of machines and materials. Evaluate the trial operation as it was carried out in the schools under your jurisdiction. Make this evaluation known to the other schools or school districts participating in the experimental program and ask for their evaluations of the classroom trials conducted by them.
3. Ask a few teachers in your school or district to develop cooperatively their own materials relating to specific subject matter, a topic, or a skill within a single grade or class. Release the teachers from other assignments to give them ample time to develop a serious trial program. Require from them a written evaluation of the trial program that is to be submitted at a definite date.
4. Arrange for training sessions for teachers either through after-school meetings or through regular extension services offered by nearby colleges or universities. Provide for time and reward for this work. Be willing to support and encourage the teachers in their efforts.

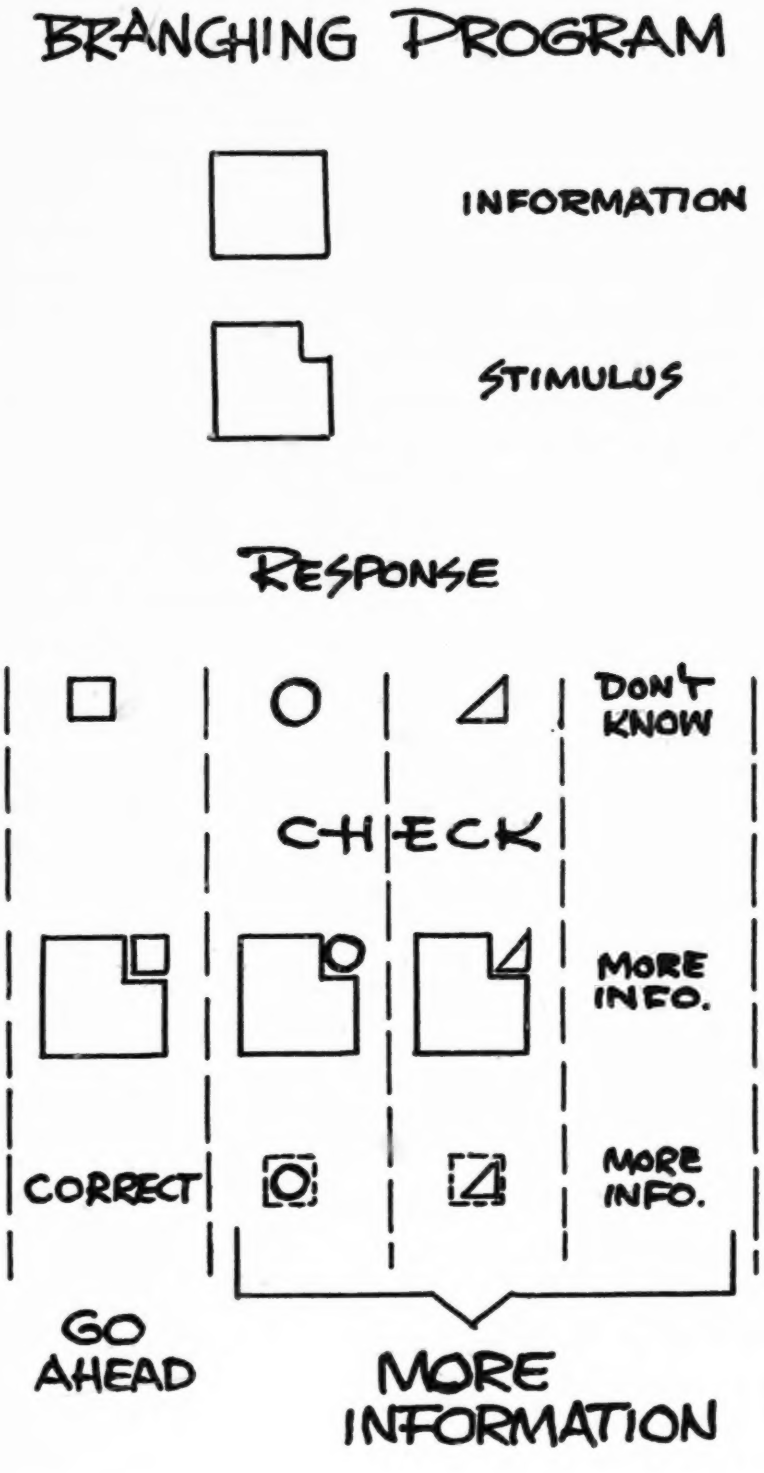
WHAT CAN TEACHERS DO?

What can teachers do to help bring about effective use of the new aids? A variety of ways and means are possible. Most teachers who have explored the research on teaching machines and programmed materials and have had opportunity to work with them, especially those teachers who have attempted to program a topic, have been impressed with their findings. Among other things, they have had fresh insights not only as to techniques of instruction and learning but even as to the subject matter itself.

It is suggested that certain team approaches be used among teachers wherever possible. Occasionally working together on a specific problem should prove of much benefit. While one person's efforts give consistency to the work being done, programs need to be reviewed and tested by others. In this way the whole staff benefits from the contributions that are made.

The following are among the steps that teachers might take in preparing for or dealing with the new aids:

1. They might evaluate published programs by using them with different classes, sections, or groups in the same subject matter. In mathematics, for example, several algebra programs are available.
2. They might compare the effectiveness of the trial programs with that of traditional teaching practices.
3. They might try various approaches in course presentation. For example, science teachers might try using a programmed physics course in conjunction with a complete film series on physics. One class might be taught with programmed materials, another with films alone, and a third with both programmed materials and a film series.
4. They might program brief segments of their own courses. The portions selected should be



small for a beginning. The topic chosen might be a highly repetitious part of the course, material that involves primarily a drill situation, or a concept that has been found generally difficult to teach.

5. Foreign language teachers might try teaching basic vocabulary in programmed form. Social studies teachers might develop short programs on social problems; these need not provide any specific solutions or answers but, rather, "branch" the student out to a variety of sources for help in finding his own solution. For example, the student might be directed to an atlas for analysis of pertinent geographical facts and to an encyclopedia for relevant statistics.

Where and How Can the New Tools Be Used?

Materials currently available tend to concentrate on the areas of science, mathematics, foreign language, grammar, and spelling. Such concentration has occurred probably because these subjects are logically organized and are sometimes highly sequential in nature; they appear to lend themselves to programmed instruction because sequence and organization are so basic to programming. However, no subject matter is excluded from the use of programming techniques, and some trials have already been started in areas such as social studies, art, and music.

Teaching machines and programmed materials could be used in the following general ways:

1. *A few machines might be used in a school for a variety of purposes.* Machines and materials might be used during the morning for remedial arithmetic students in grade seven and during the afternoon for accelerated students in freshman mathematics; and after school the machines and materials might be sent for individual study purposes to homebound students who are confined by illness or injury. A few machines and a variety of materials might be placed in a study hall or library room. Students might use these machines and materials during free-time periods before or

after school or during study periods throughout the day. A great variety of programs would be needed in this situation because some students would be using the machines and materials in the same manner as they would use library reference materials. For one student this practice would represent enrichment; for another, review; for a transfer student, makeup work covering material not taught in his prior schooling.

2. *A full class or grade might use the machines and materials for portions of a course.* Perhaps students would work the machines 20 minutes per class period or two hours a week, and pursue the more traditional types of learning activities for the balance of class time. Use of the machines might occupy two-week periods at eight different times during the year. (Under these arrangements, machines might be transferred from one class or grade to other classes or grades as in number 1 in the foregoing. This would provide multiple and maximum use of the materials but on a differing time basis.)
3. *A full class or grade might use the machines and materials for an entire course.* This might be done for experimental purposes, particularly in an advanced course in which a teacher is in attendance only part of the time or in which no teacher is available. The use of machines and materials in this fashion is certain to have far-reaching impact upon curriculum. Teachers will need to analyze critically and painstakingly the objectives and content of the course. Tests that adequately measure the specifics of course content must be designed. In relation to the information or skills that are to be communicated by the programmed material, practical applications must be prepared. Teachers cannot face these tasks and carry them to completion without having a basic understanding of the curriculum. Administrators cannot supervise nor execute such changes in a class or grade without considering the problems created by one group of students who will be "out of phase" with other students when the program-trained students are merged (in other classes or in future courses) with nonprogram-trained students.

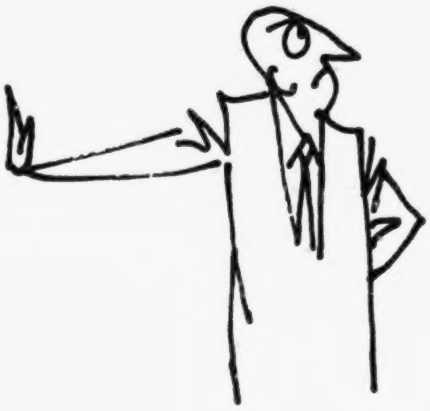
Most experiments indicate that program-trained students acquire information more quickly and more securely than students taught according to conventional classroom and textbook principles and methods. If, by the use of the new tools, time is saved and retention is greater, what additions or changes should be made in the normal scope and sequence of the curriculum? How is a selected group of students combined with groups at other stages of skill and knowledge and on different time schedules? These are questions that need thoughtful consideration.

As indicated in this chapter, teaching machines and programmed materials can serve a variety of purposes in a variety of ways. Each use will provide some value to a school at some cost. Each school can find techniques for utilizing these aids to wise advantage—techniques that would be uniquely useful to specific situations. In this respect, two points should be emphasized: (1) a school should find a "comfortable" level of experience with the machines and materials; and (2) unforeseen changes involving the students, the teachers, the scope and sequence of the curriculum, and administrative routines should be anticipated. The second point may appear to be so obvious that it needs no statement. Experience has shown, however, that innovations such as these new aids to instruction are far more revolutionary than most people anticipate. Treading new ground is always hazardous, and the best prepared pioneers are surprised.

Some Points for Consideration

Education faces several alternatives regarding the use of teaching machines and programmed materials. Among these are the following:

1. The new devices and techniques can be ignored by educators and left to others to use and develop. Two consequences of this attitude are possible: (a) education may find itself pressed to accept and use tools that are inadequate or improper to the tasks at hand; or (b) education as we know it may be replaced by an-



other system conducted by other groups for other purposes.

2. The new devices and techniques can be adopted because of persuasive publicity or because pressures are exerted for quick solutions to educational problems. Education can and should seek help for school problems. However, intelligent choice and judicious application of solutions are still responsibilities of the profession. It is not action alone that is required. The real requirement is action founded on good judgment.

3. The new devices and techniques can be systematically introduced into a variety of situations for adequate examination and evaluation. This is not a will-of-the-wisp approach but a controlled application of resources to specific problems. An alternative such as this one—applicable to anything new—seeks *true value;* it seeks that which will solidly benefit the educational program.

Teachers should not complain if they discover that now they must acquire more knowledge about diagnosing students' learning difficulties and prescribing students' performance tasks. (Fixed-scale grading as we know it may be replaced by statements of specific performance levels.) Rather, teachers should strive for increasing awareness and understanding of (1) the educational and sociological principles involved in small-group learning; (2) the educational and psychological principles involved in individual performance as related to ability; and (3) the nature and importance of step-by-step learning and the reinforcement of knowledge. (The days of simple "group participation" may prove to be inadequate in the future.) It is also a matter of importance that teachers should be prepared to design and supervise the production of relatively complex teaching materials for specific learning problems.

Administrators must be prepared to recommend and secure larger budgets that are allocated in different ways. Educational costs may be related more to instructional efficiency and less to tradition. Instructional functions may expand as technological applications reveal new instructional values in the use of such devices as teaching machines. Perhaps salaries that are double the present size will be paid to half as many teachers who are much more highly trained. The cost of instructional materials might increase five times to as much as 10 percent of the total budget.

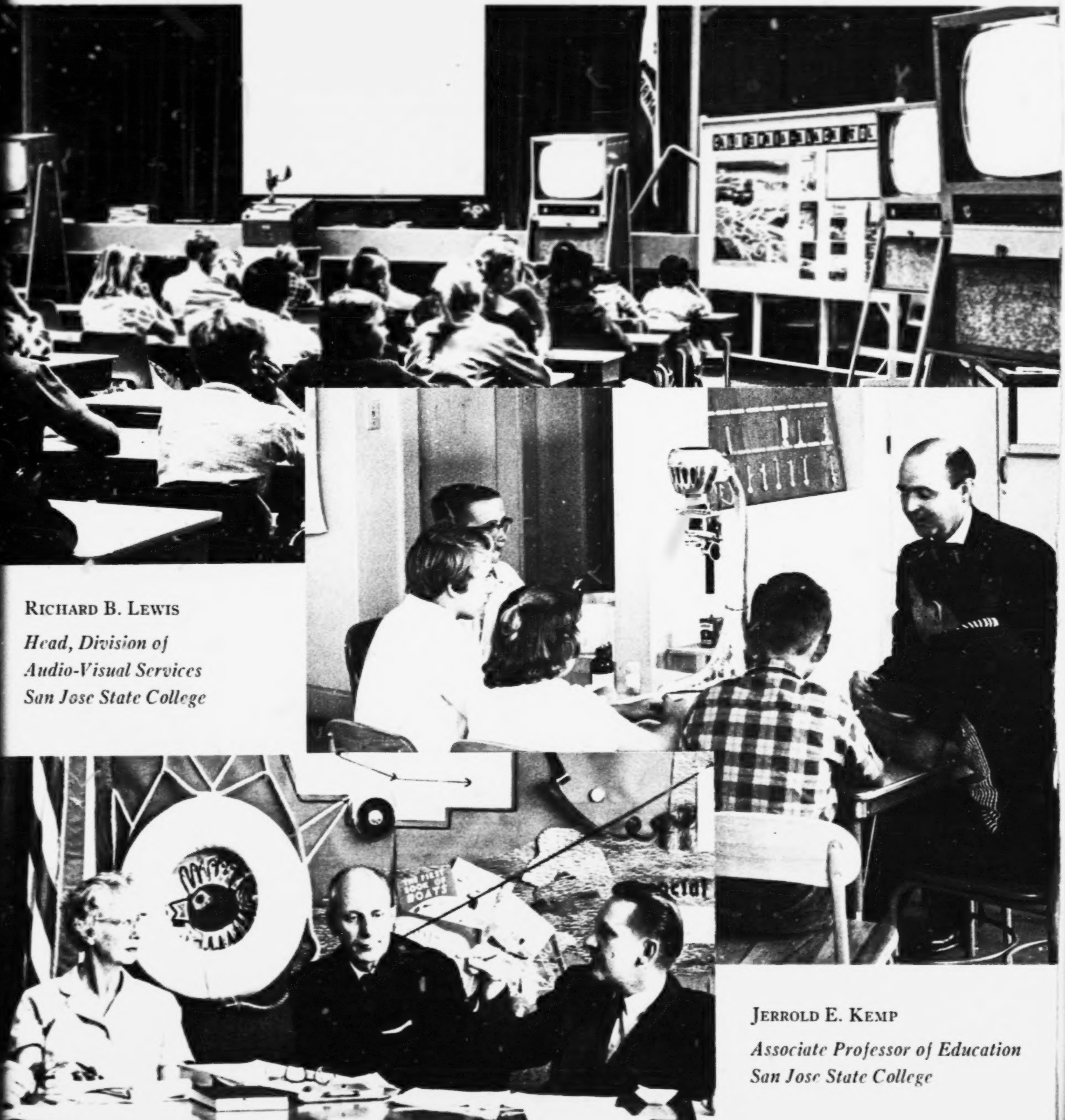
Administrators might find themselves with a radically different organization under their direction. Grade levels as we know them might disappear as students achieve specified performance levels at individual rates rather than grade years completed in grossly defined content areas. Faculties might become not groups of teachers but a collection of specialists in performance analysis, learning diagnosis, activity prescription, guidance of the individual, group supervision, materials design, and other similar and related tasks.

Teaching machines and programmed materials are part of the general technology that spells change for education. How much of what kind of change cannot be foreseen at the moment. How well education will cope with these inevitable but unforeseen changes depends upon the responsible participation of education in the development and application of such instructional tools as teaching machines and programmed materials.

CHAPTER VIII

NEW INSTRUCTIONAL PATTERNS AND THEIR IMPLICATIONS:

A Forward Look in Audio-Visual Communications



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An earlier chapter began with the premise that the responsibility of education is to provide the means by which students may learn effectively. Learning is evident when students change their behavior—when capabilities and aptitudes, originally undefined and disorganized, take on systematic patterns.

Thus, the objectives of all instruction are desirable changes in student behavior. These goals are accomplished through teaching in many subject areas and by a variety of techniques that require many and diverse special materials, equipment, and facilities. To visualize the relationships among the complex aspects of education, a rationale is presented to assist in the examination of instructional patterns.

To relate learning with typical content, let A, B, and C in the diagram that follows equal the objectives of education. Accompanying each objective are typical questions that exemplify specific desired outcomes of learning. When a student can supply appropriate answers to questions such as these and can behave accordingly in a manner considered appropriate and acceptable, he has learned.

OBJECTIVES OF EDUCATION	SPECIFIC LEARNINGS
A = Attitudes and appreciations (to be developed through expression of viewpoint and through behavior)	1. Do you respect the law? 2. Is art "practical?" 3. Do you read for rewards? 4. Do you spend money wisely?
B = Background in knowledge and information (to be acquired for use in thinking and making judgments)	1. Name the parts of a perfect flower. 2. An octagon consists of how many sides? 3. Conjugate the verb être. 4. The valence of nitrogen in HNO_3 is ________.
C = Competence in skills and performance (to be achieved for later application)	1. How fast and well do you type? 2. Do you drive well? 3. How effective is your speech? 4. Can you carry a tune?

It is not enough to outline the desired outcomes of education, for changes in behavior are determined not only by subject matter but also by specific teaching procedures and by experiences selected for students. The extent and kinds of behavior changes in students are determined to a great extent by what is planned for them to do, by the way in which they do it, and by the guidance and instruction given them by teachers.

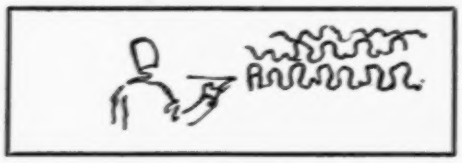
Thus, *instructional methods cannot be separated from subject content;* both are essential ingredients in teaching and learning. Methods are the procedures, schedules, activities, assignments, experiences, and the sequence of events selected by the teacher, *by plan,* to produce the most desirable change of behavior in students—the most learning in the shortest practical time.

Patterns of instruction and some examples of the methods selected by teachers to produce desired learning can be represented by X, Y, and Z in the diagrams that follow:

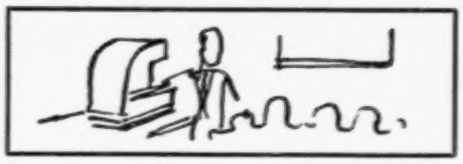
X = **TEACHER AS**
TRANSMITTER OF
INFORMATION

Teacher may transmit information to students, in groups of any size, while they listen and look.

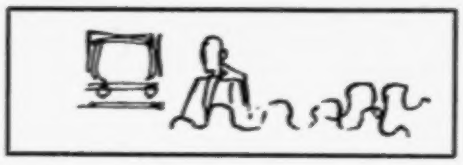
The processes and devices that facilitate this form of teaching may be:



Lecturing



Showing audio-visual materials

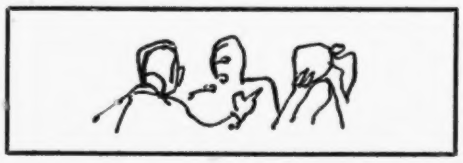


Using television

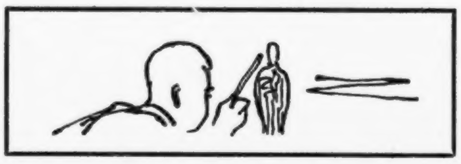
Y = **TEACHER AND**
STUDENTS
INTERACTING

Teachers and students together, desirably in small groups, interchange ideas and information, and students may practice skills under direct guidance of the teacher.

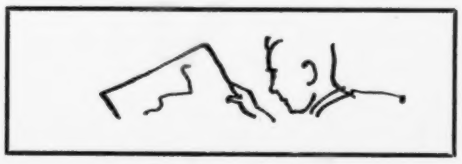
The methods and materials may be:



Discussion



Study of objects

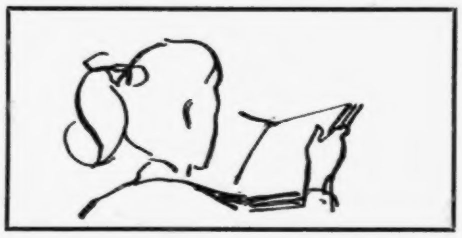


Substitutes for things

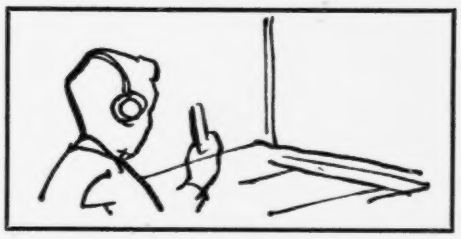
Z = **STUDENT ALONE**

Much student learning is achieved by study and practice guided by directions previously given in lecture or discussion or by materials provided by the teacher.

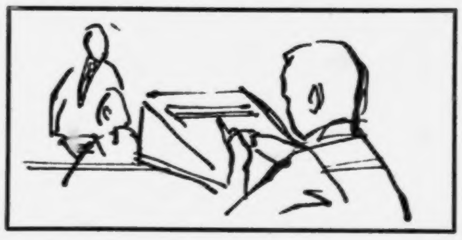
The source for student learning may be:



Books

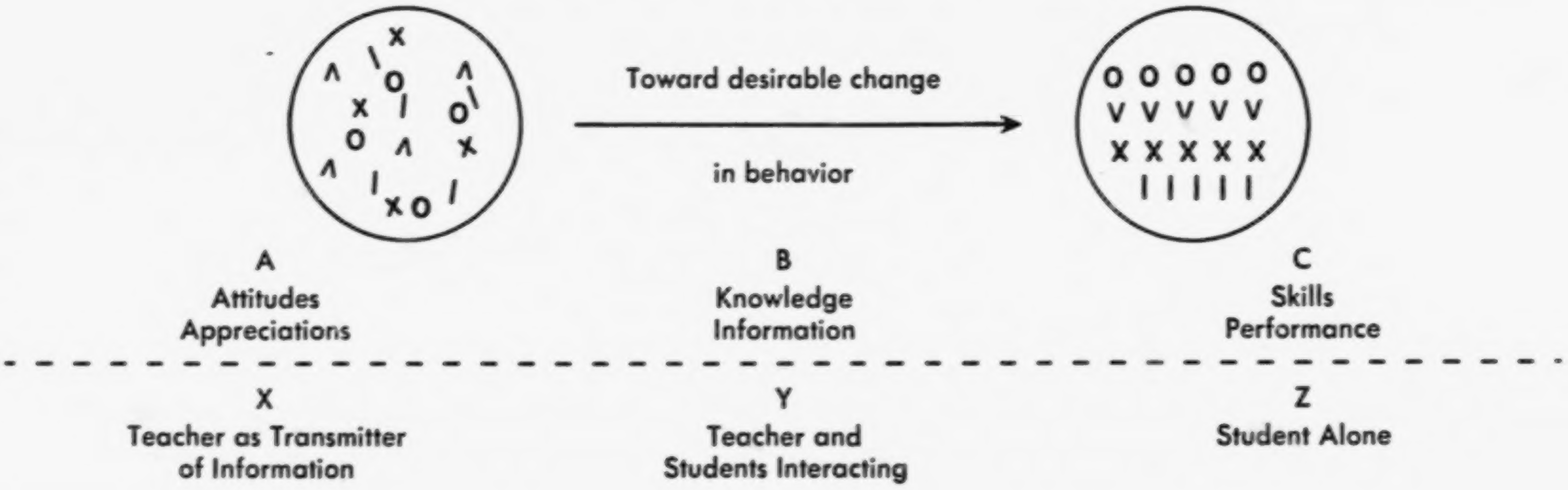


Language laboratories



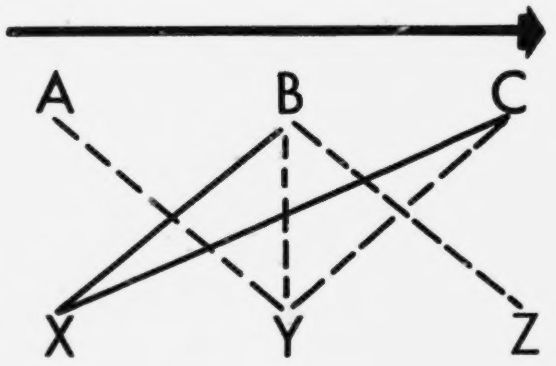
Teaching machines

Let us summarize the Teacher-Learning process as it has been presented:



Thus, above the dotted line are symbolized the *objectives* and *content* of education, and below the dotted line are the *activities* of teachers and learners used to accomplish these objectives.

In each relationship between teacher and student and between student and content, different learnings take place at the same time, and the ABC/XYZ arrangement is one of complex and varying relationships:



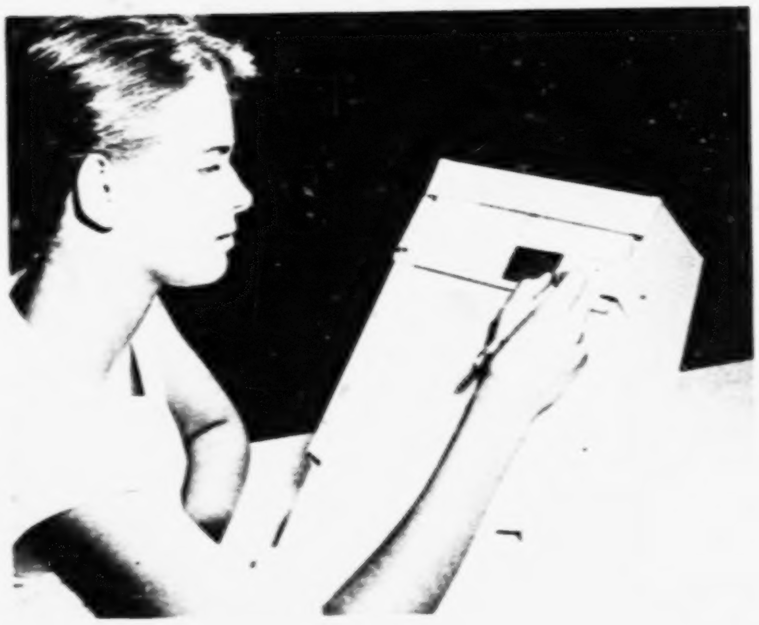
Both teacher and student have specific roles in each situation for each objective. And for each situation there are materials, equipment, and environmental conditions that can most effectively facilitate learning. Throughout most of the chapters in this publication reference has been made to the new media of communications and to their emerging roles for the improvement of instruction in science, mathematics, and foreign languages.

In Chapter II various types of audio-visual equipment and materials were listed. In relation to this information, the following questions could be asked to good advantage:

1. Which of those types would be the most appropriate, and probably the most effective, in helping the teacher present information to large groups of students? This is the X role of the teacher.
2. Which materials and devices could be used beneficially in small groups when teachers and students work together during instruction? This is the Y role of the teacher.
3. What devices and materials can the student alone use to expand his knowledge, modify his attitudes, or develop his skills? The planning for such study is the Z role of the teacher.

If the ABC/XYZ formula is used to analyze day-to-day activities in a school, one can discover many opportunities to change the process of instruction—to develop new patterns of action for the learner and the teacher. The formula is presented solely as a means of raising questions about what happens in instruction: What is the *best way* to produce any specific, desirable behavior in a student? By making presentations *to* them (X)? By talking and working *with* them (Y)? By giving students carefully planned assignments to be done *on their own* (Z)?

What have we learned from experience and from research to suggest how attitudes (A), knowledge (B), and skills (C) are *best* learned? Under what conditions and with what procedures does learning take place most rapidly and most economically in



terms of energy, time, money, materials, and facilities?

This publication is dedicated to the suggestion that improvement in the educational process is possible. Through technological developments, new patterns of instruction are both practical and possible. But the directions and extent of change for the improvement of instruction rest in how the teacher, the administrator, and all others concerned with education answer the questions that follow.

What about the facilities for learning? What kinds of buildings provide the optimum conditions for presentation of information by teachers (X)? Do the rooms used for X roles of teachers serve equally well for instruction involving small groups and teacher-student interaction (Y)? What are the essential characteristics of classroom construction that permit individual, student self-instruction (Z)? Is the school building as we have known it truly an effective place for learning in the several patterns of instruction? Are there better school building plans that can be designed to make educational procedures more efficient and more effective?

What new tools and equipment will be required in order for the ABC/XYZ situations to be fully functional?

What materials and materials' services are required to implement fully effective teaching and learning?

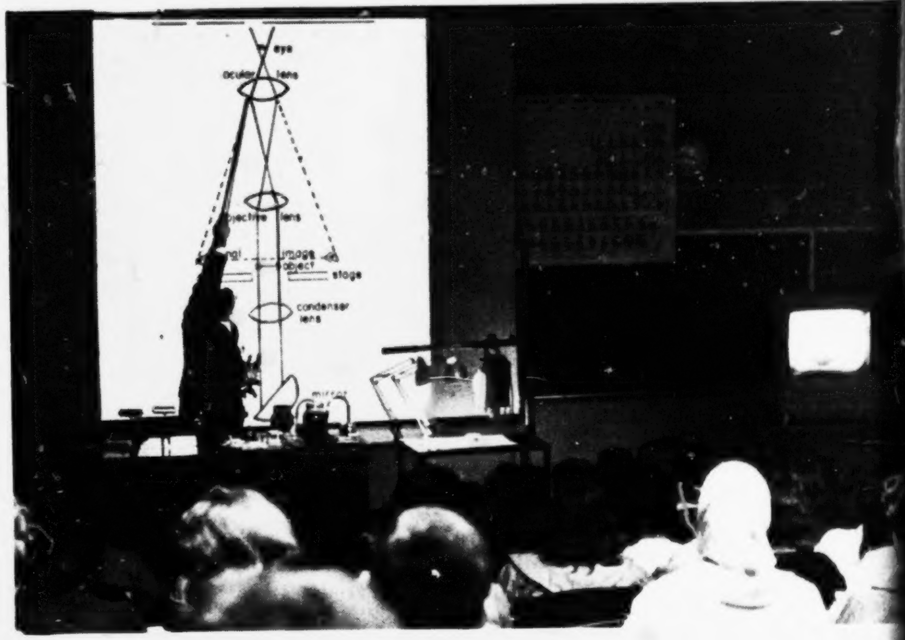
In the inevitable development and acceptance of new patterns of instruction and of new technologies to facilitate learning, what old roles, what different roles, and what new roles will be performed, and by whom?

Whatever educational processes will be manifested in the future and whatever contributions education will be able to make to society depend upon answers to questions like the foregoing ones. The things teachers and students will be doing in school and the types of facilities and equipment and materials they will be working with will depend upon continuing study of instruction and the products of instruction—that is, the quality, the amount, and the kinds of learning that take place.

CONCLUSION

Some people say that educational programs should be more like they used to be. This may not be the problem. Perhaps educational programs have been too much like they used to be. Perhaps education, in the presence of changes that have occurred and are occurring in almost every practical aspect of human endeavor, has slowly become less and less effective, less capable of changing human behavior to meet the desirable objectives of society.

The consistent application of the ABC XYZ factors in education may offer hope for the improvement of education, for the realization of the idealized



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FALL SEMESTER
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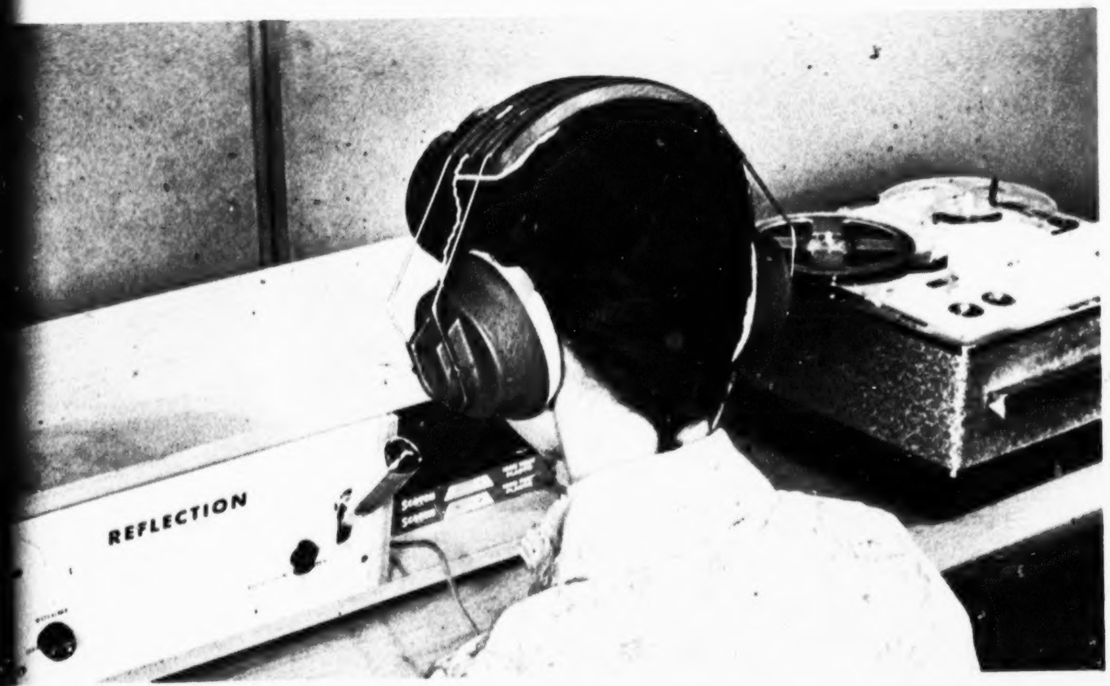
REFLECTION

role of the teacher, and for the more complete achievement of students' behavioral changes in desirable directions and at accelerated rates.

All those who have responsibility for finding ways of helping the learner need to look without reluctance to the potentials of audio-visual instructional devices—to the possibilities of television, of language laboratories, of programmed instruction and teaching machines; they need to look without prejudice to the extended and improved use of films of all types, to the creation of materials that will meet local instructional needs, and to better prepared and more widely available materials of appropriate quality and kind. These are among the ingredients that can enrich and enliven the instructional program when wise use is made of them.

SELECTED REFERENCES

NEW TECHNOLOGY IN EDUCATION

"Audio-Visual Instruction" (feature series of articles). *The National Elementary Principal,* XL (January, 1961), 5-34.

"The Audio-Visual Tools of Learning" (feature series of articles). Administration Study No. 8. *The Nation's Schools,* LXVII (February, 1961), 63-110.

Exploring Improved Teaching Patterns. Bulletin No. 243. *The Bulletin of the National Association of Secondary-School Principals.* Washington, D.C.: National Education Association, 1959 (reprint available).

FUSCO, GENE C. "Technology in the Classroom: Challenges to the School Administrator." *School Life,* XLII (March, 1960), 18-23; (May, 1960), 20-25.

HATCH, WINSLOW R., and BENNET, ANN. *Effectiveness in Teaching.* No. 2 in the series, *New Dimensions in Higher Education.* Washington, D.C.: Office of Education, U. S. Department of Health, Education, and Welfare, 1960 (OE #50006).

HATCH, WINSLOW R., and BENNET, ANN. *Independent Study.* No. 1 in the series, *New Dimensions in Higher Education.* Washington, D.C.: Office of Education, U. S. Department of Health, Education, and Welfare, 1960 (OE #50005).

"Individual Learning." *Overview,* II (March, 1961), 45-52.

MILLER, NEAL E., and OTHERS. "Graphic Communication and the Crisis in Education" (entire issue). *AV Communication Review,* Vol. V, No. 3, 1957 (early summer edition). Washington, D.C.: Department of Audio-Visual Instruction, National Education Association (issue available from NEA).

MORSE, ARTHUR D. *Schools of Tomorrow—Today!* Garden City, New York: Doubleday & Co., Inc., 1960.

New Horizons in Staff Utilization. Bulletin No. 234. *The Bulletin of the National Association of Secondary-School Principals.* Washington, D.C.: National Education Association, 1958 (reprint available).

Progressing Toward Better Schools. Third Report on Staff Utilization Studies. *The Bulletin of the National Association of Secondary-School Principals.* Washington, D.C.: National Education Association, 1960 (reprint available).

TRUMP, J. LLOYD, and BAYNHAM, DORSEY. *Focus on Change: Guide to Better Schools.* National Association of Secondary-School Principals. Chicago: Rand McNally & Co., 1961.

WYMAN, RAYMOND. "Space and Personnel: Some New Concepts." *Audiovisual Instruction,* V (May, 1960), 132-33.

Instructional Television

Allen, William H. *Television for California Schools.* Bulletin of the California State Department of Education, Vol. XXIX, No. 4, April, 1960. Sacramento: California State Department of Education.

Fletcher, Leon C. *Instructional Television Review: 1959-1961.* Menlo Park, California: Pacific Coast Publishers, 1961.

Foshay, Finette P. *Interaction in Learning: Implications for Television.* Washington, D.C.: Department of Audio-Visual Instruction. National Education Association, 1959.

Opportunities for Learning: Guidelines for Television. Washington, D.C.: Department of Audio-Visual Instruction, National Education Association, 1960.

Teaching by Television. Fund for the Advancement of Education. New York: Ford Foundation, 1961.

Television and the Teaching of English. Prepared by Neil Postman and the Committee on the Study of Television, National Council of Teachers of English. New York: Appleton-Century-Crofts, Inc., 1961.

Wyman, Raymond. *And TV, Too!* Department of Classroom Teachers and Department of Audio-Visual Instruction. Washington, D.C.: National Education Association, 1961.

Language Laboratories

A Guide for the Development of Language Laboratory Facilities. Bureau of Audio-Visual and School Library Education. Bulletin of the California State Department of Education, Vol. XXIX, No. 10, October, 1960. Sacramento: California State Department of Education.

Language Teaching Today. Edited by Felix J. Oinas. Part II, *International Journal of American Linguistics,* Vol. XXVI, No. 4, October, 1960. (Available as Publication No. 14, Indiana University Research Center in Anthropology, Folklore, and Linguistics, Bloomington, Indiana.)

Modern Techniques in Teaching Foreign Languages. Edited by Elliott H. Kone. Bulletin of the Connecticut Audio-Visual Education Association. New Haven, Connecticut: Yale University Audio-Visual Center, 1960.

Suggestions for Teaching Foreign Languages by the Audio-Lingual Method: A Manual for Teachers. Prepared by Gustave Mathieu and James S. Holton under the direction of Everett V. O'Rourke. Bulletin of the California State Department of Education, Vol. XXIX, No. 7, July, 1960. Sacramento: California State Department of Education.

PHYSICAL FACILITIES

De Bernardis, Amo, and Others. *Planning Schools for New Media: A Guide for Boards of Education, School Administrators, and Architects.* In cooperation with Office of Education, U. S. Department of Health, Education, and Welfare. Portland, Oregon: Division of Education, Portland State College, 1961 (available from the college).

Planning for Schools with Television: Design for ETV. Prepared by Dave Chapman, Inc., Industrial Design. New York: Educational Facilities Laboratories, 1960.

Schools for Team Teaching: Profiles of Significant Schools. Prepared by Evans Clinchy. New York: Educational Facilities Laboratories, 1961.

FILMS

And No Bells Ring. 16-mm motion picture, sound, black and white; 57 minutes. National Association of Secondary-School Principals, National Education Association.

TEACHING MACHINES AND PROGRAMMED LEARNING

Automatic Teaching: The State of the Art. Edited by Eugene Galanter. New York: John Wiley & Sons, 1959.

Automation in Education: Machines and Men as Teachers and Learners. Reprint, 27 pp. *Teachers College Record,* Vol. LXII, No. 3, December, 1960. New York: Bureau of Publications, Teachers College, Columbia University.

Rigney, Joseph W., and Fry, Edward B. "Current Teaching-Machine Programs and Programming Techniques" (entire issue). *AV Communication Review,* Vol. IX, No. 3, May-June, 1961, 122 pp. Washington, D.C.: Department of Audio-Visual Instruction, National Education Association (issue available from NEA).

"Self-Instructional Devices" (feature series of articles). *Audiovisual Instruction,* VI (April, 1961), 126-62. Washington, D.C.: Department of Audio-Visual Instruction, National Education Association.

Stolurow, Lawrence M. *Teaching by Machine.* Cooperative Research Monograph No. 6. Washington, D.C.: Office of Education, U. S. Department of Health, Education, and Welfare, 1961 (OE #34010).

Teaching Machines and Programmed Learning: A Source Book. Edited by Arthur A. Lumsdaine and Robert Glaser. Washington, D.C.: Department of Audio-Visual Instruction, National Education Association, 1960.

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